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NEW ENGLAND DIV APR 80

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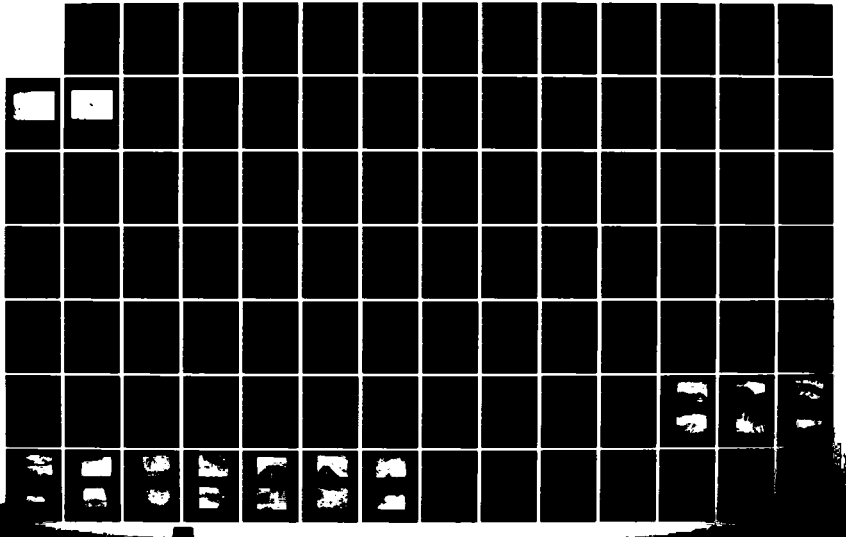
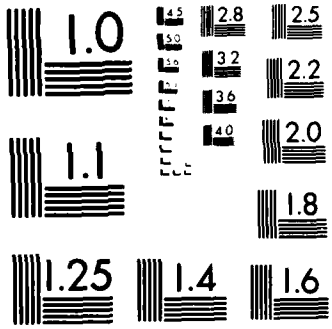
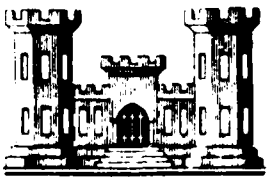




CONNECTICUT RIVER BASIN
GLASTONBURY , CONNECTICUT

BUCKINGHAM RESERVOIR DAM
CT 00244

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEER
WALTHAM , MASS. 02154

APRIL 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Buckingham Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Conn. River Basin
Glastonbury, Conn.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Buckingham Reservoir Dam is an earth embankment 400 ft. in length and 30 ft. in maximum height. The width of the dam crest is about 15 ft. As a result of visual inspection and the review of limited available data regarding this project, the dam, spillway and dike appear to be in poor condition. For the combination of dam size (small) and downstream hazard (significant), a range in the magnitude of the test flood of 100-year frequency flood to the ½ PMF is given.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

11 SEP 1980

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

Inclosed is a copy of the Buckingham Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, City of Manchester, c/o Mr. Frank J. Jodaitis, Water & Sewer Administrator, 494 Main Street, Manchester, Connecticut 06040.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

BUCKINGHAM RESERVOIR DAM

CT 00244

CONNECTICUT RIVER BASIN

GLASTONBURY, CONNECTICUT

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	CT 00244
Name of Dam:	Buckingham Reservoir Dam
Town:	Glastonbury
County and State:	Hartford, Connecticut
Stream:	Roaring Brook
Date of Inspection:	7 November, 1979

BRIEF ASSESSMENT

The Buckingham Reservoir Dam is an earth embankment 400 feet in length and 30 feet in maximum height. The width of the dam crest is about 15 feet. The upstream face of the dam varies in slope from 1 on 2 to 1 on 3 (vertical to horizontal). The downstream slope is 1 on 2¼. A dike and spillway section is located to the left of the dam. The spillway is 50 feet long, constructed of concrete. The upstream dike embankment slopes at 1 on 2 (vertical to horizontal). The downstream embankment also slopes at 1 on 2. A 16" diameter supply main (to Manchester) and a 24" diameter blow-off pipe pass through the gatehouse and dam.

Buckingham Reservoir is used for public water supply. It has a storage of 380 acre-feet and a dam height of 30 feet. The dam is thus classified as "small" in size. The probable dam failure impact area is largely undeveloped woodland. However, two factories located in the village of East Glastonbury would be flooded to a depth of about 2 feet above first floor levels. With the possibility of the loss of a few lives and the probability of appreciable economic losses in the event of the dam failure, the dam has been classified as having a "significant" hazard potential.

As a result of the visual inspection and the review of limited available data regarding this project, the dam, spillway and dike appear to be in poor condition. The vertical and horizontal alignment of the dam is good. The downstream slope has several trees and high brush, especially at the abutments. Erosion gullies up to 8 inches deep on the downstream slope, due to vehicular traffic, were noted. The riprap on the upstream slope is in good condition with a few unprotected areas. Considerable seepage as evidenced by wet area downstream from the toe of dam and at the toe of the natural slope at the left abutment was noted. Several springs were observed, although these springs did not appear to carry fine material. The concrete spillway and dike are in fair condition. The concrete spillway had areas of

erosion, spalling and deterioration. Seepage was noted at the base of the left training wall. The dike was overgrown with brush; however, no seepage was observed. Apparent settlement or slumping was observed at upstream edge of dike's crest immediately to the right of the spillway. Apparent movement has occurred at the downstream toe adjacent to the left spillway training wall. The vertical and horizontal alignment was good. A few minor erosion gullies were noted on the downstream slope.

For the combination of dam size (small) and downstream hazard (significant), a range in the magnitude of the test flood of 100-year frequency flood to the ½ PMF is given. A test flood of 100-year frequency flood was selected for this project. The maximum spillway capacity is 2,040 CFS at a stage of 5.7 feet above the spillway crest (equal to the top of dam). The capacity of the spillway is adequate to pass the 100-year test flood outflow of 1,260 CFS without overtopping the dam and dike.

Within one year of receipt of this Phase I Inspection Report, the owner should retain a qualified registered engineer to accomplish the following: 1) Investigate the seepage occurring downstream from the toe of the dam and at the toe of the natural slope at the left abutment. The investigation should include an evaluation of the ability of the existing seepage collection system to adequately control and monitor the seepage. The need for additional drainage and collection systems, especially at the toe of the natural slope at the left abutment, should be considered; 2) Investigate the seepage occurring at the base of the left spillway training wall to determine whether there is any danger of internal erosion of the spillway dike behind the wall and 3) repair all spalled and deteriorated concrete.

The owner should also carry out the following operational and maintenance procedures: 1) Monitor on a regular basis the seepage occurring downstream from the toe of the dam and downstream from the toe of the natural slope at the left abutment. 2) Inititate regular readings of the quantity of seepage being collected by the underdrain system. 3) Remove the trees growing on the downstream slope at the abutments of the main dam. 4) The erosion gullies on the downstream slope of the dam at Sta 2+30 should be filled and protected by planting with grass. Vehicular traffic should not be allowed on the slope. 5) Replace missing riprap on upstream slope of dam. 6) Monitor on a regular basis the seepage occurring downstream at the base of the left spillway training wall. 7) Remove trees growing at the downstream toe of the spillway dike and in the downstream spillway channel. 8) The brush growing on the spillway dike should be cleared. 9) Backfill erosion gullies and 1 ft. deep hole on the downstream slope of the dike. 10) Monitor on a regular basis the two locations on the spillway dike slopes which show indications of past movement, i.e., the upstream edge of the crest immediately to the right of the spillway and the downstream toe immediately to the left of the spillway. 11) Engage a qualified registered engineer to make a comprehensive technical inspection of the dam and

dike once every year. 12) Establish a surveillance program for use during and immediately after heavy rainfall, and also a warning program to follow in case of emergency conditions. 13) Sediment should be removed from the outlet of the 24" diameter blow-off and the channel cleared of brush. The 16" diameter blow-off should be located and inspected and 14) Blow-off valves should be operated on a scheduled basis to ensure that they are in good working condition.

S. Giavara, P.E.
President

Registered CT. 7634

This Phase I Inspection Report on Buckingham Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which m otherwise be detectable if inspected under the normal ope ng environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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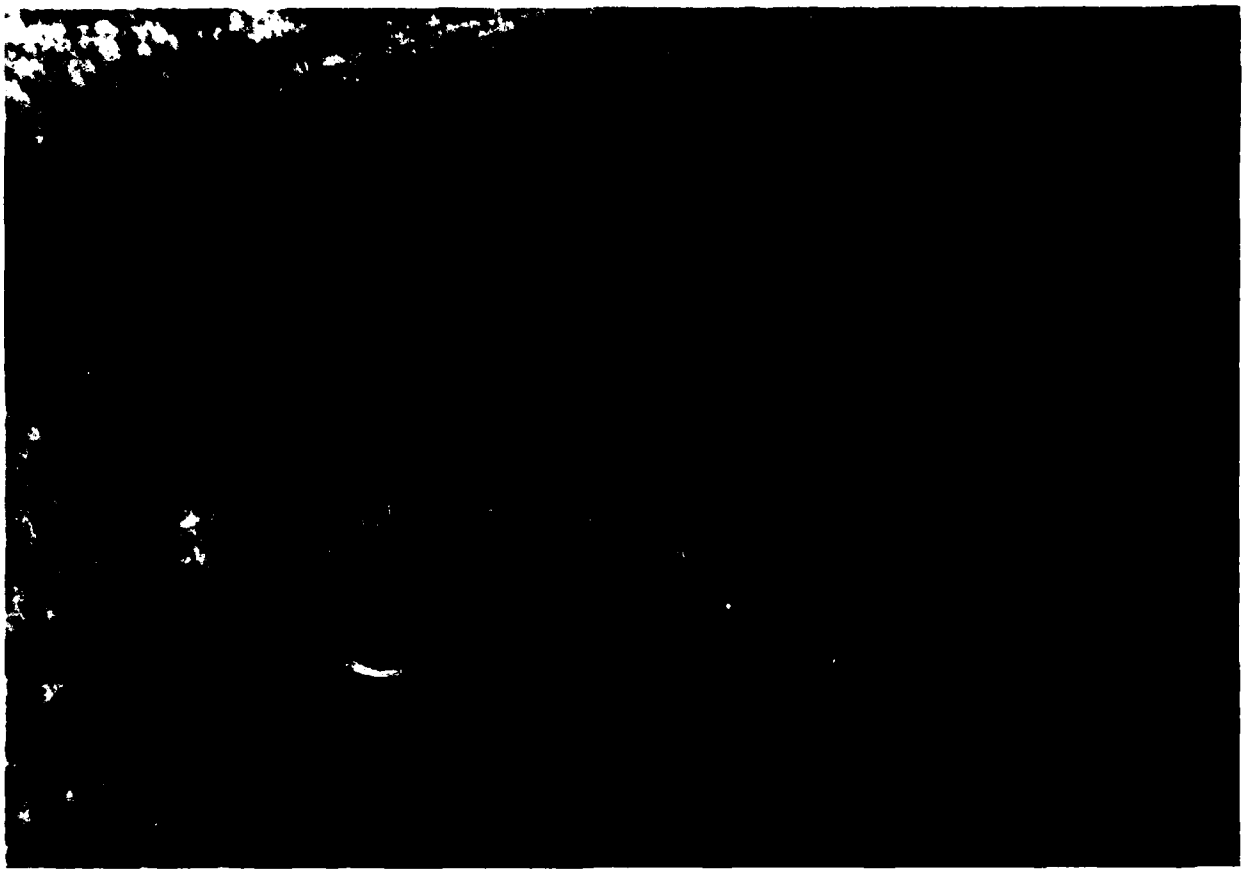
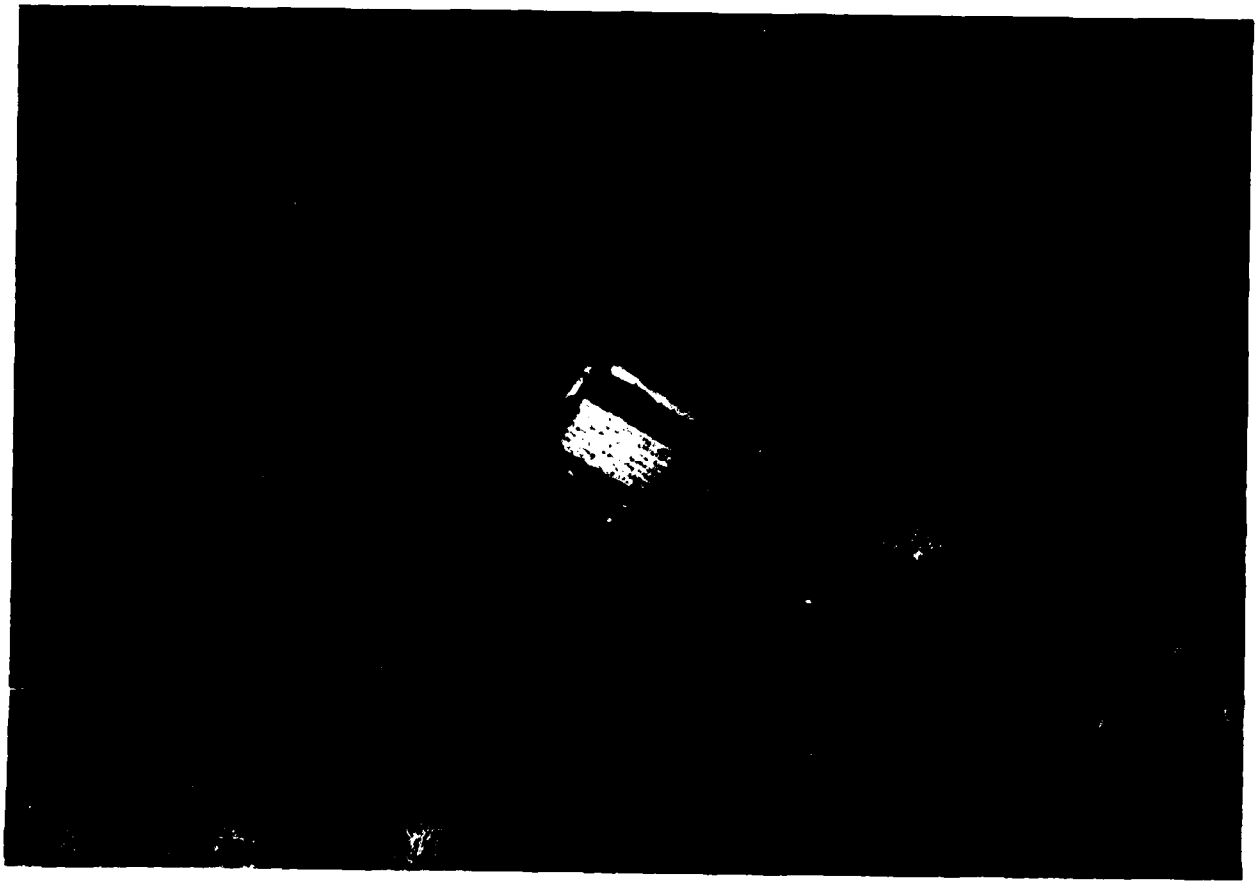
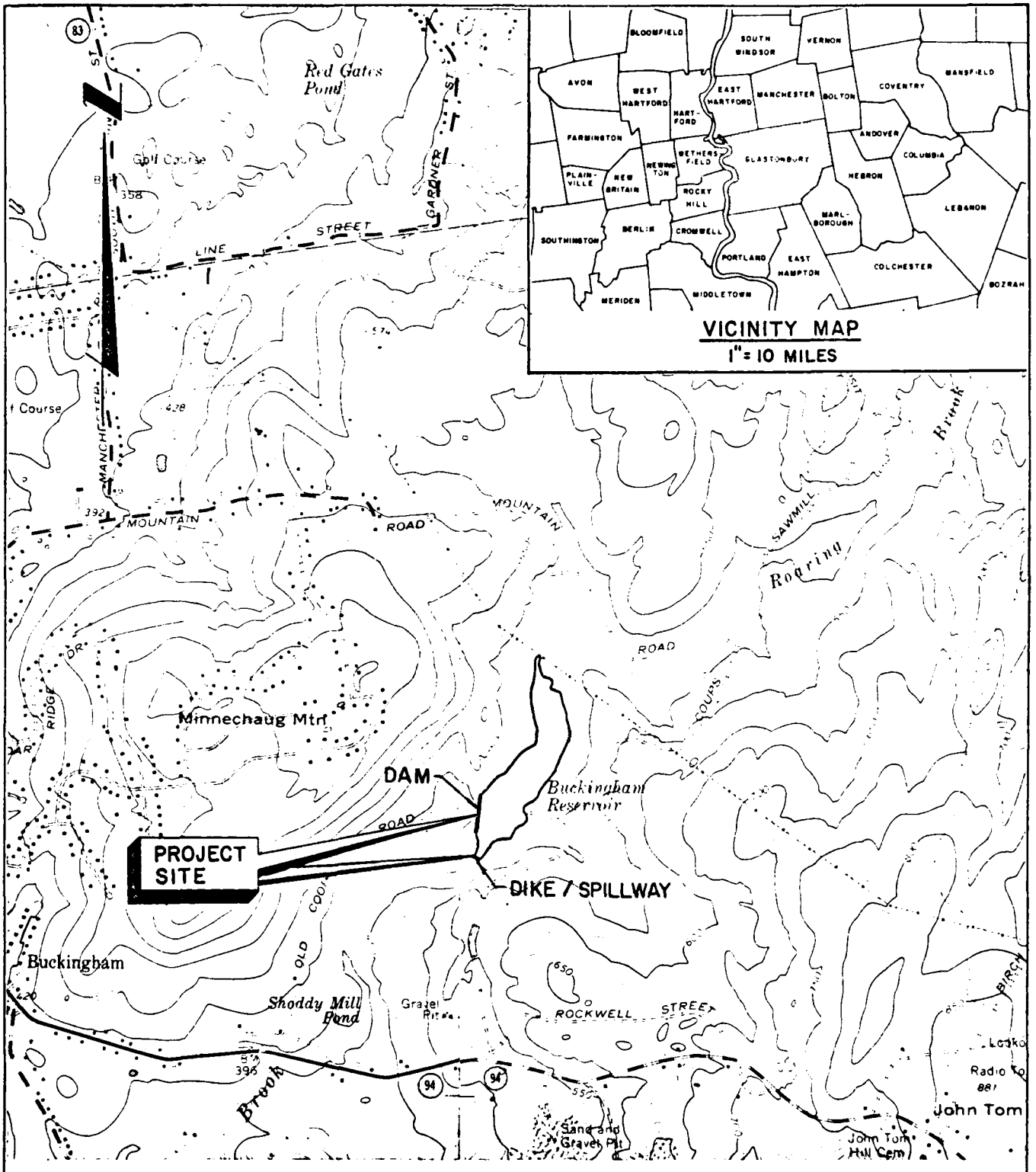
APPENDIXES



OVERVIEW PHOTO
Buckingham Reservoir Dam



OVERVIEW PHOTO
Buckingham Reservoir Dam
at
Spillway and Dike



SCALE IN FEET

2000 1000 0 2000

BUCKINGHAM RESERVOIR DAM

LOCATION MAP

GLASTONBURY , CONNECTICUT

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
BUCKINGHAM RESERVOIR DAM - CT 00244

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection through the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Flaherty Giavara Associates, P.C. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to Flaherty Giavara Associates, P.C. under a letter of 19 October 1979 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0001 has been assigned by the Corps of Engineers for this work.

b. Purpose.

1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

2) Encourage and assist the States to initiate quickly effective dam safety programs for non-federal dams.

3) To update, verify and complete the National Inventory of Dams.

1.2 DESCRIPTION OF THE PROJECT:

a. Location. Buckingham Reservoir Dam (AKA Roaring Brook Dam No. 1) is located in Glastonbury, Connecticut on Roaring Brook. Access to the reservoir is from Old Coop Road and Route 94. The reservoir is located about 1½ miles east of Buckingham. The reservoir is shown on the U.S.G.S. Topographic Map "Marlborough, Connecticut" at a latitude of 41°43'02" and a longitude of 72°29'56". The Location Map on page vii shows the location of the structure.

b. Description of Dam and Appurtenances. The Buckingham Reservoir Dam is an earth embankment 400 feet in length and 30 feet in maximum height. The width of the dam crest is about 15 feet at an elevation of 458.7 NGVD. (Note: All elevations from plans have been converted to NGVD.)

The upstream face of the dam varies in slope from 1 on 2 to 1 on 3 (vertical to horizontal). The face of the dam is protected with riprap from El. 455 NGVD to El. 442 NGVD and with about 18 inches of stone and gravel to El. 432 NGVD. The downstream slope is 1 on 2¼, and the surface is loamed. A heavy stone fill is in place at the downstream toe. An impervious blanket was placed beneath the upstream slope and an impervious core material (loam) was rolled in layers or puddled just upstream of a concrete core wall at the centerline of the embankment. Steel sheet piling was driven beneath the core wall and embankment section.

A downstream drainage collection system consisting of underdrains and drainage chambers (equipped with weirs) has been constructed downstream of the dam (subsequent to original dam construction).

A 16" diameter supply main (to Manchester) and a 24" diameter blow-off pipe pass through the gatehouse and dam.

A dike and spillway section is located approximately 200 feet to the left of the dam. The spillway is 50 feet long with a maximum height of 27 feet, constructed of concrete, with a top elevation of El. 452 NGVD (flash boards in place at elevation 453 NGVD). The top of the dike is at elevation 458.7 NGVD (field measured). The upstream embankment slopes at 1 on 2 (vertical to horizontal). The downstream embankment also slopes at 1 on 2.

The upstream slope consists of impervious material covered with gravel and stone; the downstream slope is constructed of coarse material. A concrete core wall is located in the center of the dike.

The spillway discharge enters Roaring Brook about 2,000 feet downstream of the spillway.

c. Size Classification. Buckingham Reservoir Dam has a storage volume of 380 acre-feet and a dam height of 30 feet. Storage of less than 1,000 acre-feet and a height of less than 40 feet classify this structure in the "small" category according to guidelines published by the Corps of Engineers.

d. Hazard Classification. The dam is classified as having a "significant" hazard potential. The probable dam failure impact area is largely undeveloped woodland. However, two factories located in the village of East Glastonbury would be flooded to a depth of about 2 feet above first floor levels. With the possibility of some loss of life and the probability of appreciable economic losses in the event of dam failure, the dam has been classified as having a significant hazard potential.

e. Ownership. City of Manchester, c/o Mr. Frank J. Jodaitis, Water and Sewer Administrator, 494 Main Street, Manchester, Connecticut, Phone: 203-647-3111.

f. Operator. The dam is operated by the Manchester Water Department. Mr. Robert Young (203-647-3111) is responsible for the operation of this dam.

g. Purpose of Dam. The purpose of this dam is to impound the reservoir for use as a public water supply.

h. Design and Construction History. Design information consists of plans for construction of the dam and spillway dated February 1924. The dam was designed by C. Saviles, Consulting Engineer. The dam was visited by the design engineer frequently during construction. Work began about September 1, 1923 and was completed about August 1, 1924. A downstream seepage collection system was added after construction of the dam. The date of this post construction change is unknown.

i. Normal Operational Procedure. The Buckingham Reservoir Dam is a surface water storage facility for the Manchester Water Department. Water can be taken off through the upper gatehouse in a 16" diameter water supply main. A 24" diameter blow-off can be operated to lower the water level in the reservoir. The blow-off was not operated during the inspection. It is not known whether the flashboards on the spillway are ever removed for maintenance.

1.3 PERTINENT DATA:

a. Drainage Area. The drainage area is 4.5 square miles of upland terrain that is generally well wooded and undeveloped. The drainage area forms the headwaters of Roaring Brook.

b. Discharge at Dam Site.

1) A 24-inch diameter cast iron pipe passes through the dam and was observed at the toe of downstream slope. A 16-inch conduit is indicated on the plans but could not be located in the field. Assuming both outlet conduits are operational, the maximum outlet works discharge would be approximately 120 CFS.

2) There are no known records of past floods or flood stage heights at the dam.

3) The ungated spillway capacity at the top of dam - 2040 cfs @ El. 458.7 without flashboards and 1530 cfs @ El. 458.7 with flashboards in place.

4) The ungated spillway capacity at the test flood elevation - 1257 cfs @ El. 457.1.

5) The gated spillway capacity at normal pool elevation is not applicable at this dam.

6) The gated spillway capacity at test flood elevation is not applicable at this dam.

7) The total spillway capacity at test flood elevation - 1257 cfs @ El. 457.1.

8) The total project discharge at the top of dam is 2040 cfs at El. 458.7 without flashboards and 1530 cfs at El. 458.7 with flashboards in place.

9) The total project discharge at test flood elevation - 1257 cfs @ El. 457.1.

c. Elevations. (Feet above National Geodetic Vertical Datum: NGVD)

1) Streambed at toe of dam.....429±

2) Bottom of cut-off.....407±

3) Maximum tailwater.....N/A

4) Recreation pool.....N/A

5) Full flood control pool.....N/A

6) Spillway crest.....452±, with flashboards 453±

7) Design surcharge.....Unknown

8) Top of dam and dike.....458.7±

9) Test flood surcharge.....457.1±

d. Reservoir. (Length in Feet)

1) Normal pool (Spillway crest).....3,000±

2) Flood control pool.....N/A

3) Spillway crest pool.....3,000±

4) Top of dam.....4,000±

5) Test flood pool.....3,800±

e. Storage. (acre-feet)

1) Normal pool (Spillway crest).....110

2) Flood control pool.....N/A

3) Spillway crest pool.....110

4) Top of dam.....380

5) Test flood pool.....300

f. Reservoir Surface. (acres)

1) Normal pool (Spillway crest).....35

2) Flood control pool.....N/A

3) Spillway crest.....35

4) Test flood pool.....53

5) Top of dam.....60

g. Dam.

		Dam	Dike
1)	Type:	Earth embankment	Earth embankment concrete spillway
2)	Length:	400+ feet	w/spillway: 175± ft.
3)	Height:	30 feet	27 feet
4)	Top Width:	15 feet	15 feet
5)	Side Slopes:	U/S 3-2 horizontal to 1 vertical; D/S 2½ horizontal to 1 vertical	U/S & D/S 2 horizontal to 1 vertical.
6)	Zoning:	Riprap; gravel; sand and gravel, impervious material	
7)	Impervious Core:	Concrete core	Concrete core
8)	Cut-off:	Steel sheet piling below core wall	None
9)	Grout Curtain:	None	None

h. Diversion and Regulating Tunnel.

1)	Type:	N/A
2)	Length:	N/A
3)	Closure:	N/A
4)	Access:	N/A
5)	Regulating Facilities:	N/A

i. Spillway.

1)	Type:	Concrete gravity section with stepped D/S face
2)	Length of Weir:	50 feet

3)	Crest Elevation:	452± feet; 453± feet with flashboards
4)	Gates:	None
5)	U/S Channel:	Concrete training walls from reservoir, rock and gravel bed
6)	D/S Channel:	Concrete training walls, riprap bed

j. Regulating Outlets.

1)	Invert:	429.5±
2)	Size:	16 and 24 inch diameter
3)	Description:	24-inch blow-off and 16-inch supply with blow-off
4)	Control Mechanism:	Manually operated gate valves

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

The following documents which contain the principal information regarding this dam and its appurtenances were reviewed in the preparation of this report.

a. Drawings. Roaring Brook Reservoir Glastonbury Conn. Drawing of Dam for the South Manchester Water Company, scale 1" = 10', Feb. 1924. Dam No. 1, Drawing No. 1 through No. 3 (see Appendix B).

Additionally, several items of correspondence pertaining to the project, including the results of periodic inspections conducted by the State were reviewed (see Appendix B).

2.2 CONSTRUCTION:

No information is available concerning the foundation preparation or embankment construction. However, the design engineer certified the following relative to construction of the dam.

> "...this dam, to the best of my knowledge and belief was actually constructed as shown on the three sheets of drawings Nos. 1, 2, 3, entitled 'Roaring Brook Reservoir, Glastonbury, Conn. Drawings of Dam for the South Manchester Water Company. Dam No. 1, dated February 1924, approved 3/31/24.
>
> "This dam was visited by me frequently during construction. Work commenced about 9/1/23 and completed about 8/1/24.
>
> "The material used in the soil core on the upstream side of the dam and in the impervious blanket extending upstream was constructed essentially as shown on the plans. The loam was excellent quality, free from large stones, roots and vegetable matter and carefully placed and consolidated. The concrete, although occupying a somewhat minor place as regards the stability of the structure, was of excellent quality, carefully placed and of first rate appearance after the forms were removed. It was composed of one part Vulcanite cement and six parts of clean bank gravel from a pit near the site of the work. The cement appeared to be of excellent quality and was carefully housed before use. The concrete set well and was very hard at all times after the forms were removed. Practical tests were made on the ground with large size blocks of concrete mixed in different

proportions and the 1:6 mix chosen as giving the best results for practical purposes. This mix seemed the equivalent of a proportioned 1:2:4 mix."

Apparently subsurface drains of various sizes were added to the original design drawings. The date of construction of these drains is unknown. Details shown on the drawings are in good agreement with field observations.

2.3 OPERATION:

Formal operational records are not available for this dam. Operation of the dam is by the Town of Manchester Water Department.

2.4 EVALUATION:

a. Availability. Only limited engineering information is available for this dam.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Validity. Only minor conflicts have been noted between the available data and the observations made during the inspection. In general, there is no reason to question the validity of the available data.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

a. General. Based on the visual inspection, the dam and its appurtenances, Buckingham Reservoir Dam, spillway and dike, appear to be in poor condition. The dam is an earth embankment with a riprap protection on the upstream face, an upstream impervious blanket, a concrete core wall and loamed downstream slope, with heavy stone fill at the toe. A concrete spillway section 50 feet long is located to the left of the main dam embankment. The spillway section is constructed in the center of a dike (embankment) with a concrete core wall.

The vertical and horizontal alignment of the dam is good. The downstream slope has several trees and high brush, especially at the abutments. Erosion gullies up to 8 inches deep on the downstream slope, due to vehicular traffic, were noted. The riprap on the upstream slope is in good condition with a few unprotected areas. Considerable seepage as evidenced by wet area downstream from the toe of dam and at the toe of the natural slope at the left abutment was noted. Several springs were observed, although these springs did not appear to carry fine material.

The concrete spillway and dike are in poor condition. The concrete spillway had areas of erosion, spalling and deterioration. Seepage was noted at the base of the left training wall. The dike was overgrown with brush; however, no seepage was observed. Apparent settlement or slumping was observed at upstream edge of dike's crest immediately to the right of the spillway. Apparent movement has occurred at the downstream toe adjacent to the left spillway training wall. The vertical and horizontal alignment was good. A few minor erosion gullies were noted on the downstream slope. It was difficult to determine continuity of riprap coverage due to brush and vegetative debris.

b. Dam.

1) Upstream Face - The upstream slope of the dam has riprap protection up to about 3 ft. below the crest, as shown in Photo No. 1. An occasional opening was observed in the riprap, but the overall condition is generally good. No significant erosion was observed on the slope.

2) Crest - The crest of the dam is covered with grass and some low brush, and is in generally good condition, as shown in Photos No. 2 and No. 3. The gatehouse for the outlet works is located on the crest, as can be seen in Photos No. 1 and No. 3.

3) Downstream Slope - Photos No. 4, No. 5, No. 8 and No. 9 show the general condition of the downstream slope. The slope is covered with grass and some brush. Several trees (up to 1-ft.-diameter) are growing on the downstream slope near the right abutment, as shown in Photo No. 6. Trees are also growing at the left abutment, as shown in Photo No. 9. Vehicular traffic on the slope at Sta 2+30 has created gullies up to 8-in.-deep, as shown in Photo No. 6. Several animal holes up to 6-in.-diameter were observed on the slope, and several large animal holes up to 1½-ft.-diameter were observed near the downstream toe.

Much of the area downstream from the toe of the dam is saturated and spongy, and a large area between Sta 4+00 and 5+00 is covered with standing water (Photo No. 11). The wet area is about 80 feet long by 20 feet wide, located 10 to 30 feet downstream of the toe. A small spring was observed at about Sta 4+30, approximately 30 ft. downstream from the toe. The seepage from the spring had no visible turbidity.

Seepage was also observed at the toe of the natural slope at the left abutment (approximately Sta 6+00). Several small springs were observed at the toe of the slope in this area. The seepage from the springs had no visible turbidity.

The dam has an extensive downstream seepage collection system. The seepage collection system is not shown on the original construction drawings, indicating that the system was installed subsequent to the original construction of the dam. One of the available drawings shows a sketch of the seepage collection system superimposed on a copy of the original construction drawing. This drawing shows two seepage collection chambers,both of which were observed in the field. These are visible in Photo No. 7.

A third seepage collection chamber, which is not shown on the drawing, was observed about 50 to 60 ft. downstream from the dam at approximately Sta 1+75. Considerable flow was observed in the seepage collection system at the time of inspection. The collection chambers are equipped with weirs for measuring the volume of flow (see Photo No. 10). A representative of the owner, present during the inspection, indicated that the volume of seepage is not being monitored.

4) Blow-off - The outlet of a 24" diameter cast iron pipe was located and found to be ½ full of sediment, as shown in Photo No. 12. The end of the pipe had a hairline crack in it. The pipe discharges into a four foot wide channel that is heavily overgrown with brush. A second blow-off, 16 inches in diameter, is shown on the plans but could not be located in the field. The gatehouse control valves for the blow-offs were not inspected or operated during the site visit.

c. Appurtenant Structures. The spillway is located in an earth dike to the left of the main dam, as shown in Photos No. 13 and No. 14. The general configuration of the spillway and

spillway dike is shown in the overview photo. Water was overflowing the spillway at the time of inspection.

1) Spillway Dike - The available construction drawings indicate that the spillway dike has a concrete core wall and that the left section of the dike embankment and left half of the spillway are founded on rock.

The upstream slope of the dike has riprap up to about 3 ft. below the crest. The riprap is covered with brush and vegetative debris above the water line, as shown in Photo No. 14, making it difficult to evaluate the continuity of the riprap coverage.

The crest of the dike is grass covered (see Photo No. 15). As can be seen in the photo, the upstream portion of the crest immediately to the right of the spillway appears to have settled or slumped toward the reservoir.

The downstream slope of the dike is covered with grass and low brush. Several small trees are growing at the downstream toe of the slope. A few erosion gullies were observed on the downstream slope. A hole, about 1 foot deep and 1 foot in diameter, was observed on the slope about 8 feet to the left of the spillway and about 8 feet downslope from the crest.

2) Spillway - The spillway weir and training walls are concrete (see Photo No. 16). The spillway training wall is in fair condition, with some spalling noted (Photo No. 17). There are short sections of stone masonry wall at the downstream ends of the spillway training walls, as shown in Photo No. 18. The downstream end of the stone masonry wall on the left side of the spillway has been displaced about 4-5 inches downslope. 12" high, wooden flashboards were in place on the spillway crest and are in good condition.

Considerable seepage was observed at several locations along the base of the left spillway training wall. Seepage was observed at the base of both the concrete training wall (Photo No. 18) and the stone masonry wall section. The seepage had no visible turbidity. The available construction drawings indicate that the concrete training wall on this side of the spillway is founded on rock.

The downstream spillway channel is a natural stream bed, as shown in Photo No. 19. There are a number of small trees growing in and overhanging the channel, as shown in the photo.

3) Spillway Apron - The spillway discharges onto a riprap apron located between the retaining walls. The rocks range up to 3 feet in diameter, and there appears to have been some movement of the rock in the past. There is no evidence of degradation.

d. Reservoir Area. The land around the reservoir's perimeter has mild to moderate slopes and is well wooded. There is no evidence of slides or unstable slopes (see Photo No. 20).

e. Downstream Channel. The spillway apron discharges into a natural channel that is 15 to 25 feet wide and 2 to 3 feet deep (Photo No. 19). The channel has a natural bed of sand and gravel, with some cobbles and boulders. Minor erosion of the banks is occurring for the first 200+ feet downstream of the spillway dike, and sand bars with some vegetation have formed in the center. The channel banks and floodplain are heavily wooded.

3.2 EVALUATION:

On the basis of the results of the visual inspection, the dam appears to be in poor condition. The inspection disclosed the following items which require attention:

a. A considerable amount of seepage is occurring downstream from the toe of the dam and at the toe of the natural slope at the left abutment. Several small springs were noted in these areas. Although no evidence of sediment transport was observed, this seepage warrants further investigation.

b. Trees are growing on the downstream slope at both abutments of the main dam.

c. Vehicular traffic on the downstream slope at Sta 2+30 has resulted in formation of erosion gullies on the slope.

d. Considerable seepage is occurring along the base of the left spillway training wall.

e. There is some indication of past movement at two locations on the spillway dike slopes; the upstream edge of the crest immediately to the right of the spillway appears to have settled or slumped toward the reservoir and the downstream end of the stone masonry wall on the left side of the spillway has been displaced downslope.

f. Several small trees are growing at the downstream toe of the spillway dike, and the dike slopes are partially covered with brush.

g. Trees are growing in the downstream spillway channel.

h. The outlet for the 24" diameter blow-off conduit is half full of sediment and the channel is heavily overgrown with brush. The outlet for the 16" diameter blow-off could not be located.

i. Animal holes were noted on the downstream slope of the dam.

j. Riprap is missing at some locations on the upstream slope.

k. A 1-foot deep hole on the downstream slope of the dike.

l. Erosion gullies on the downstream slope of the dike.

SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 OPERATIONAL PROCEDURES:

a. General. The Buckingham Reservoir Dam is a surface water storage facility for the Manchester Water Department. Water can be taken off through the upper gatehouse in a 16-inch diameter water supply main. A 24" diameter blow-off can be operated to lower the water level in the reservoir. The blow-off was not operated during the inspection. It is not known whether the flashboards on the spillway are ever removed for maintenance.

b. Description of any Warning System in Effect. There is no formal warning system in effect in the event of a failure or partial failure of the structure.

4.2 MAINTENANCE PROCEDURES:

a. General. It does not appear that any formal maintenance procedures are practiced at the dam. Numerous trees and brush have overgrown the downstream slope.

b. Operating Facilities. There are no formal maintenance procedures followed for the operating facilities.

4.3 EVALUATION:

Regular operation maintenance procedures for this dam and its appurtenances have not been developed or implemented.

An emergency action plan should be prepared to prevent or minimize the impact of failure. This plan should list the expedient action to be taken and authorities to be contacted in emergency situations.

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 GENERAL DATA:

The Buckingham Reservoir Dam is an earth structure with a concrete spillway. The crest length of the dam is 400 feet; its height is 30 feet. The spillway is separated from the dam by natural high ground; therefore the spillway is constructed in conjunction with an earth dike. The 50-foot-long centrally located spillway discharges onto a series of stone steps and thence directly into a natural channel.

The watershed area is 4.5 square miles of upland terrain that is well wooded. The majority of the land within the watershed is presently undeveloped. Approximately 5 percent of the land within the watershed drains into ponds or lakes upstream of the dam.

5.2 DESIGN DATA:

No specific design data is available for this watershed or the structures of Buckingham Reservoir Dam. In lieu of existing design information, U.S.G.S. Topographic Maps (Scale 1" = 2,000') were utilized to develop hydrologic parameters. Some of the pertinent hydraulic design data was obtained and/or confirmed by actual field measurements at the time of the visual field inspection.

5.3 EXPERIENCE DATA:

Historical data for recorded discharges is not available for this dam.

5.4 TEST FLOOD ANALYSIS:

The test flood for determining the spillway adequacy is based upon Corps of Engineers guidelines. The size classification of the dam is "small" based upon a height of 30 feet and storage volume of 380 acre-feet. The hazard potential is "significant" due to the land use downstream of the dam. The test flood required by Corps of Engineers guidelines for this size dam and hazard potential can range from the 100-year return frequency flood to the ½ probable maximum flood (PMF).

The test flood selected for this project is the 100-year flood, due to the possibility of the loss of a few lives and the probability of appreciable economic loss due to dam failure. The relative size of the dam and reservoir storage volume was taken into account when selecting the test flood at the lower end of the range.

The magnitude of the test flood was determined by using a hydrograph method developed by the U.S. Department of Agriculture, Soil Conservation Service, and described in the publication "Design of Small Dams," by the U.S. Bureau of Reclamation.

The test flood was developed based on a runoff rate for a storm with a 6 hour duration. The test flood for this duration storm was computed to be 1634 CFS. Triangular hydrographs were developed based on the computed spillway test flood inflow rates.

The hydrograph was routed through the reservoir using a computer program based on stage-storage and stage-discharge data. The reservoir was assumed to be full and level with the spillway crest prior to the storm event. The flashboards were assumed to be in place during routing of the test flood. In addition, it was assumed that the outlet conduits were closed throughout the test flood duration. The computations indicate that the test flood peak inflow rate of 1634 CFS is reduced to a peak outflow rate of 1257 CFS, which represents a reservoir attenuation effect of 23 percent.

The peak flood stage at the spillway is at elevation 457.1 NGVD, which is 1.6 feet below the crest of the dam. The spillway can therefore pass 100 percent of the test flood outflow. The maximum spillway capacity is 2040 CFS, without overtopping the dam (a stage of 5.7 above the spillway crest El. 453.0 NGVD).

5.5 DAM FAILURE ANALYSIS:

The downstream impact of a dam failure was analyzed using the Corps of Engineers "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs" dated April 1978.

Based upon an assumed breach width of 80 feet, which is equal to 40% of the dam's width at mid-height, the peak flood flow due to failure would be 22,087 CFS with an initial depth of 30 feet just downstream of the dam. The total flow (base flow plus failure outflow) is 24,128 CFS.

The probable impact area is largely undeveloped woodland. However, two active factories located about 2 miles downstream of the dam would be flooded with about 2± feet of water above their first floors. They are the Peerless Woodworking Company and Quality Name Plate Company located in the village of East Glastonbury, Connecticut. The economic loss is anticipated to be appreciable if dam failure were to occur. The depth of water at the downstream impact area prior to and just after assumed failure is 5 and 8 feet respectively.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL OBSERVATIONS:

The visual inspection did not disclose any immediate stability problems.

Features indicating slope movement were observed at two locations on the spillway dike. The appearance of these features suggests limited surficial movement rather than large deep-seated movement.

The discharge observed near the downstream toe of the main dam showed no evidence of sediment transport; however, they warrant further investigation. The source of the flows should be investigated and appropriate recommendations developed.

6.2 DESIGN AND CONSTRUCTION DATA:

The available data consists of three construction drawings entitled "Roaring Brook Reservoir, Drawings of Dam for the South Manchester Water Company, Dam No. 1," dated February 1924 and an undated sketch of a seepage collection system superimposed on a copy of one of the construction drawings.

The available data is not sufficient to permit a formal stability analysis. The present evaluation is based primarily upon the visual inspection.

6.3 POST-CONSTRUCTION CHANGES:

The existing seepage collection system was apparently installed subsequent to the original construction of the dam, since it is not shown on the original construction drawings. No information was available on the design and construction details of the collection and monitoring system.

6.4 SEISMIC STABILITY:

Buckingham Reservoir Dam is located in Seismic Zone 1 and, in accordance with the recommended Phase I guidelines, does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

a. Condition. The visual inspection indicates that the dam is in poor condition. The major concerns with respect to the long-term performance of the dam are:

1) Seepage is occurring downstream from the toe of the dam and at the toe of the natural slope at the left abutment. Several small springs were noted in these areas.

2) Considerable seepage is occurring along the base of the left spillway training wall.

3) There is some indication of past movement at two locations on the spillway dike slopes.

b. Adequacy. The engineering information available was limited and thus assessment of the condition of the dam was based primarily on the results of the visual inspection, past operational performance of the structure and sound engineering judgement.

c. Urgency. The recommendations and remedial measures presented in Sections 7.2 and 7.3 should be implemented by the owner within one year of receipt of this Phase I inspection report.

7.2 RECOMMENDATIONS:

The owner should retain a qualified registered engineer to accomplish the following:

a. Investigate the seepage occurring downstream from the toe of the dam and at the toe of the natural slope at the left abutment. The investigation should include an evaluation of the ability of the existing seepage collection system to adequately control and monitor the seepage. The need for additional drainage and collection systems, especially at the toe of the natural slope at the left abutment, should be considered.

b. Investigate the seepage occurring at the base of the left spillway training wall to determine whether there is any danger of internal erosion of the spillway dike behind the wall.

c. Repair all spalled and deteriorated concrete.

7.3 REMEDIAL MEASURES:

a. Operation and Maintenance Procedures. The owner should:

1) Monitor on a regular basis the seepage occurring downstream from the toe of the dam, downstream from the toe of the natural slope at the left abutment, and at the base of the left spillway training wall.

2) Initiate regular readings of the quantity of seepage being collected by the underdrain system.

3) Remove the trees growing on the downstream slope at the abutments of the main dam, at the downstream toe of the spillway dike, and in the downstream spillway channel. The roots should be removed and backfilled. The brush growing on the dam and spillway dike slopes should be cleared.

4) The erosion gullies on the downstream slope of the dam at Sta 2+30 should be filled and protected by planting with grass. Vehicular traffic should not be allowed on the slope.

5) All animal holes on the downstream slope of the dam should be backfilled.

6) Replace missing riprap on upstream slope of dam.

7) Backfill erosion gullies and 1 ft. deep hole on the downstream slope of the dike.

8) Monitor on a regular basis the two locations on the spillway dike slopes which show indications of past movement, i.e., the upstream edge of the crest immediately to the right of the spillway and the downstream toe immediately to the left of the spillway.

9) Engage a qualified registered engineer to make a comprehensive technical inspection of the dam and dike/spillway once every year.

10) Establish a surveillance program for use during and immediately after heavy rainfall, and also a warning program to follow in case of emergency conditions.

11) Sediment should be removed from the outlet of the 24" diameter blow-off and the channel cleared of brush. The 16" diameter blow-off should be located and inspected.

12) Blow-off valves should be operated on a scheduled basis to ensure that they are in good working condition.

7.4 ALTERNATIVES:

There are no practical alternatives to the recommendations contained in Sections 7.2 and 7.3.

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT BUCKINGHAM RESERVOIR DAM **DATE** Nov. 7, 1979

TIME 0900

WEATHER Cloudy - 45°F

W.S. ELEV. ____ **U.S.** ____ **DN.S.**

PARTY:

1. R. Smith, FGA, Project Manager
2. J. MacBroom, FGA, Hydraulics/Hydrology
3. R. Murdock, GEI, Geotechnical
4. D. Shields, GEI, Geotechnical
5. R. Young, Manchester Water Department

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: BUCKINGHAM RESERVOIR DAM **DATE:** Nov. 7, 1979

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	None observed.
Pavement Condition	No pavement, grass covered.
Movement or Settlement of Crest	None observed.
Lateral Movement	None observed.
Vertical Alignment	No misalignment observed.
Horizontal Alignment	No misalignment observed.
Condition at Abutment and at Concrete Structures	Trees growing on downstream slope at abutments.
Indications of Movement of Structural Items on Slopes	None observed.
Trespassing on Slopes	Vehicular traffic on downstream slope at Sta 2+30.
Sloughing or Erosion of Slopes or Abutments	Erosion gullies on downstream slope at Sta 2+30, due to vehicular traffic.
Rock Slope Protection - Riprap Failures	Riprap on upstream slope - good condition.
Unusual Movement or Cracking at or near Toes	None observed.
Unusual Embankment or Downstream Seepage	Considerable seepage downstream from toe of dam and at toe of natural slope at left abutment. Several springs observed.
Piping or Boils	None observed.
Foundation Drainage Features	Extensive downstream seepage collection system.
Toe Drains	Plans show stone fill toe-drain - not visable in the field.
Instrumentation System	Weirs in seepage collection chambers.
Vegetation	Crest and downstream slope are grass covered with some low brush. Trees growing on downstream slope at abutments.

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: BUCKINGHAM RESERVOIR DAM **DATE:** Nov. 7, 1979

AREA EVALUATED	CONDITIONS
DIKE EMBANKMENT	
Crest Elevation	Spillway Dike.
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	None observed.
Pavement Condition	No pavement, grass covered.
Movement or Settlement of Crest	Apparent settlement or slumping at upstream edge of crest immediately to the right of the spillway.
Lateral Movement	Apparent movement at downstream toe at left spillway training wall.
Vertical Alignment	No misalignment observed.
Horizontal Alignment	No misalignment observed.
Condition at Abutment and at Concrete Structures	Good, except for apparent movement adjacent to spillway (see above).
Indications of Movement of Structural Items on Slopes	Downstream end of stone masonry training wall on left side of spillway is displaced about 4 to 5 in. downslope.
Trespassing on Slopes	No evidence of trespassing.
Sloughing or Erosion of Slopes or Abutments	Few minor erosion gullies on downstream slope.
Rock Slope Protection - Riprap Failures	Riprap on upstream slope - difficult to determine continuity of coverage due to brush and vegetative debris.
Unusual Movement or Cracking at or near Toes	Apparent movement at downstream toe at left spillway training wall.
Unusual Embankment or Downstream Seepage	Seepage at base of left spillway training wall.
Piping or Boils	None observed.
Foundation Drainage Features	None.
Toe Drains	None.
Instrumentation System	Crest and slopes are grass covered.
Vegetation	Brush on slopes and several small trees at downstream toe.

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: BUCKINGHAM RESERVOIR DAM DATE: Nov. 7, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Not visable, underwater.
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: BUCKINGHAM RESERVOIR DAM DATE: Nov. 7, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	Control tower in good condition. The outlet works could not be inspected during the site visit.
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System in Gate Chamber	

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: BUCKINGHAM RESERVOIR DAM DATE: Nov. 7, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Buckingham Reservoir Dam DATE: Nov. 7, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain Holes	Not applicable
Channel	Not applicable
Loose Rock or Trees Overhanging Channel	Not applicable
Condition of Discharge Channel	Not applicable

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: BUCKINGHAM RESERVOIR DAM DATE: Nov. 7, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Not applicable.
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	
General Condition of Concrete	Spillway traning wall in fair condition, with some spalling noted.
Rust or Staining	None.
Spalling	Some spalling noted.
Any Visible Reinforcing	No visible reinforcing.
Any Seepage or Efflorescence	Seepage at base of left training wall.
Drain Holes	None.
c. Discharge Channel	
General Condition	Natural streambed in fair condition
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	Trees overhanging channel.
Floor of Channel	Trees growing in floor of channel.
Other Obstructions	None.

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: BUCKINGHAM RESERVOIR DAM DATE: Nov. 7, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SERVICE BRIDGE	
a. Superstructure	None.
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat and Backwall	

APPENDIX B

ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Buckingham Reservoir Da

I.D. NO. CT 00244

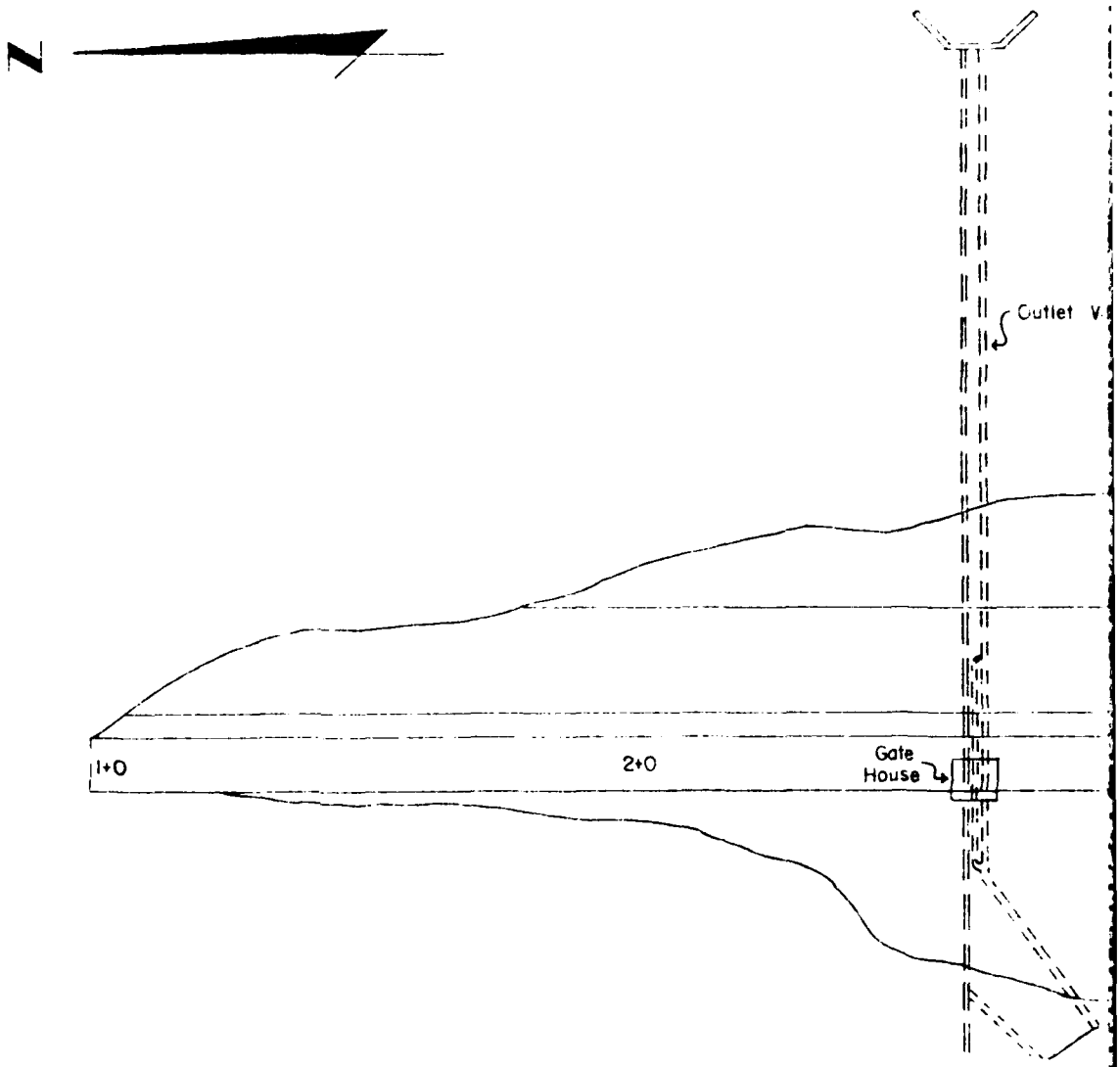
ITEM	REMARKS
AS-BUILT DRAWINGS	Construct plans - Manchester Water Department files
REGIONAL VICINITY MAP	Available from U.S.G.S.
CONSTRUCTION HISTORY	United Data - Manchester Water Department files
TYPICAL SECTIONS OF DAM	From plans
OUTLETS - Plan	From plans, field measurements
- Details	From plans
- Constraints	Unknown
- Discharge Ratings	None available
RAINFALL/RESERVOIR RECORDS	Unavailable
DESIGN REPORTS	None
GEOLOGY REPORTS	None
DESIGN COMPUTATIONS	
HYDROLOGY & HYDRAULICS	None
DAM STABILITY	None
SEEPAGE STUDIES	None
MATERIALS INVESTIGATIONS	
BORINGS RECORDS	None
LABORATORY	None
FIELD	None

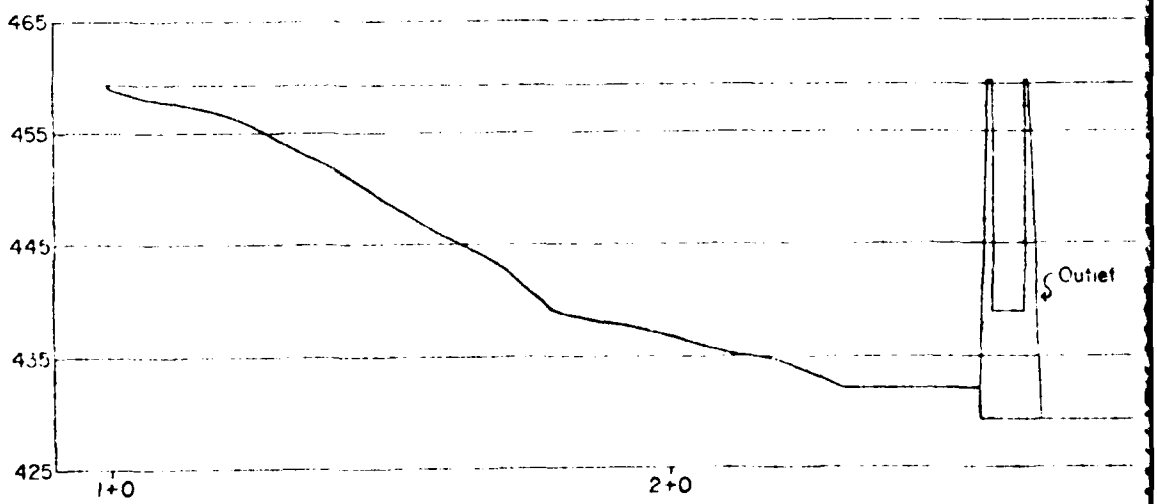
CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

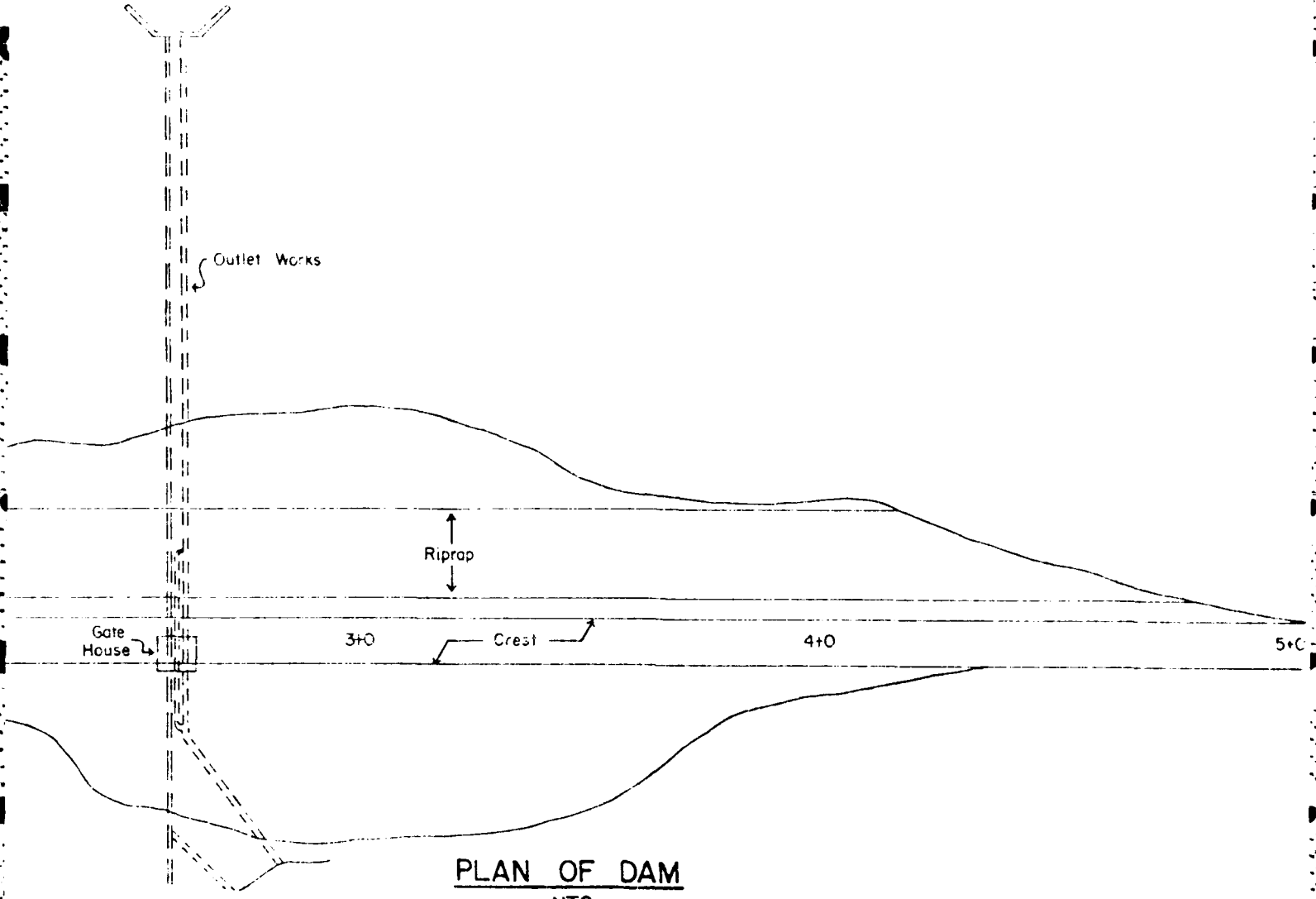
NAME OF DAM Buckingham Reservoir Dam

I.D. NO. CT 00244

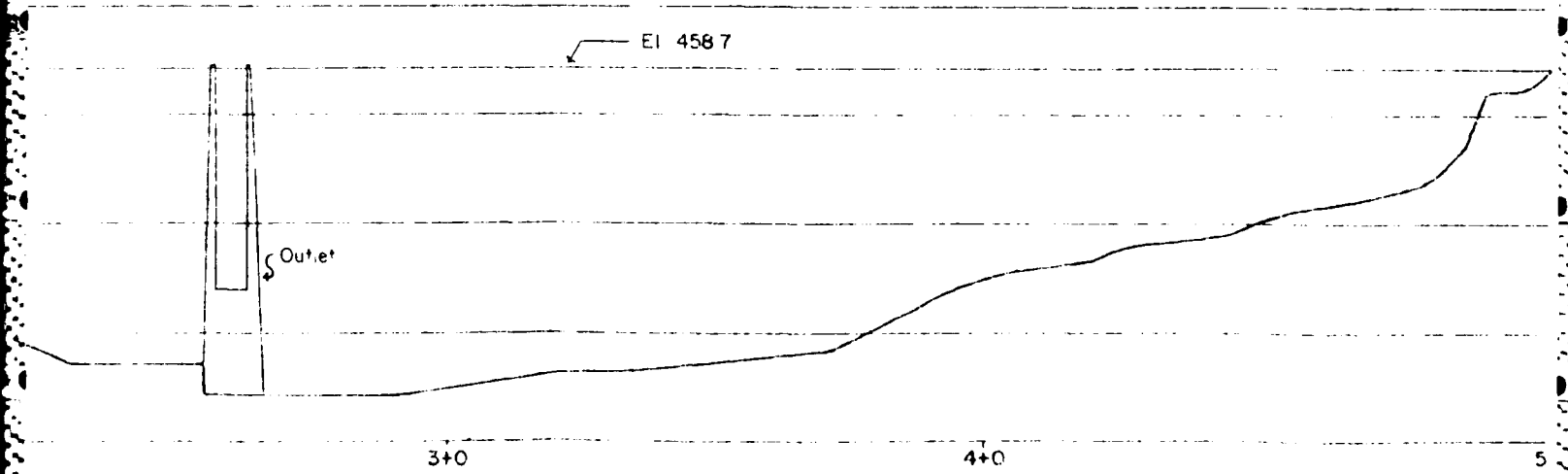
ITEM	REMARKS
POST-CONSTRUCTION SURVEYS OF DAM	None available
BORROW SOURCES	Unknown
MONITORING SYSTEMS	Unknown
MODIFICATIONS	Downstream underdrain system, sketch available
HIGH POOL RECORDS	
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown
MAINTENANCE OPERATION RECORDS	Unavailable
SPILLWAY PLAN	From plans
SECTIONS	From plans
DETAILS	From plans
OPERATING EQUIPMENT PLANS & DETAILS	From plans


N
Outlet
1+0
2+0
Gate
House


465
455
445
435
425
1+0
2+0
Outlet

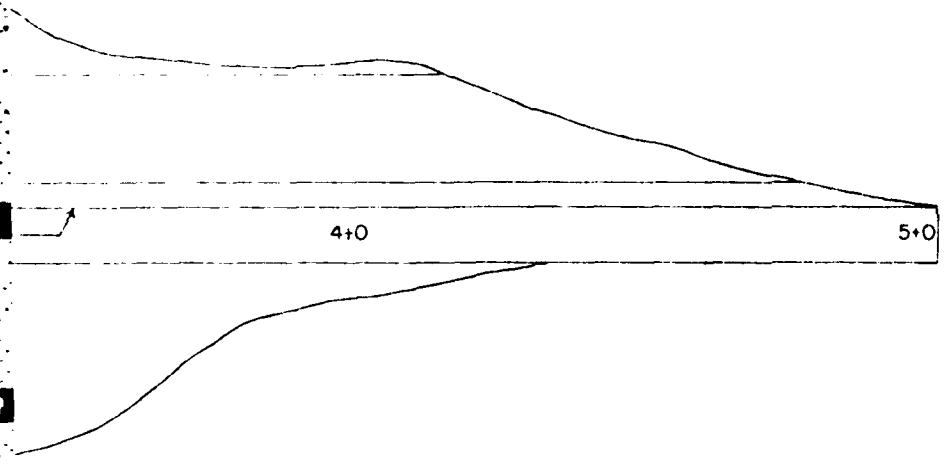


PLAN OF DAM
NTS



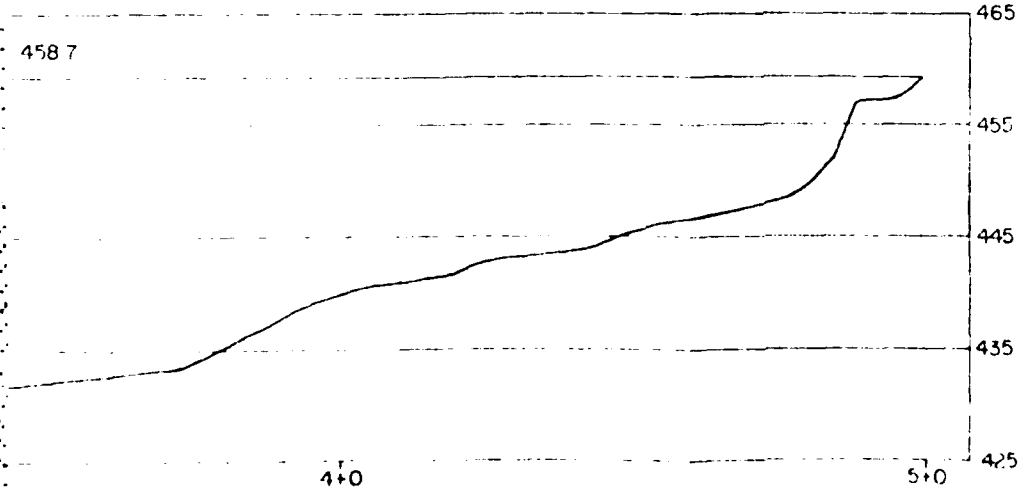
PROFILE OF DAM
NTS

BUCKINGHAM F



OF DAM

NTS



OF DAM

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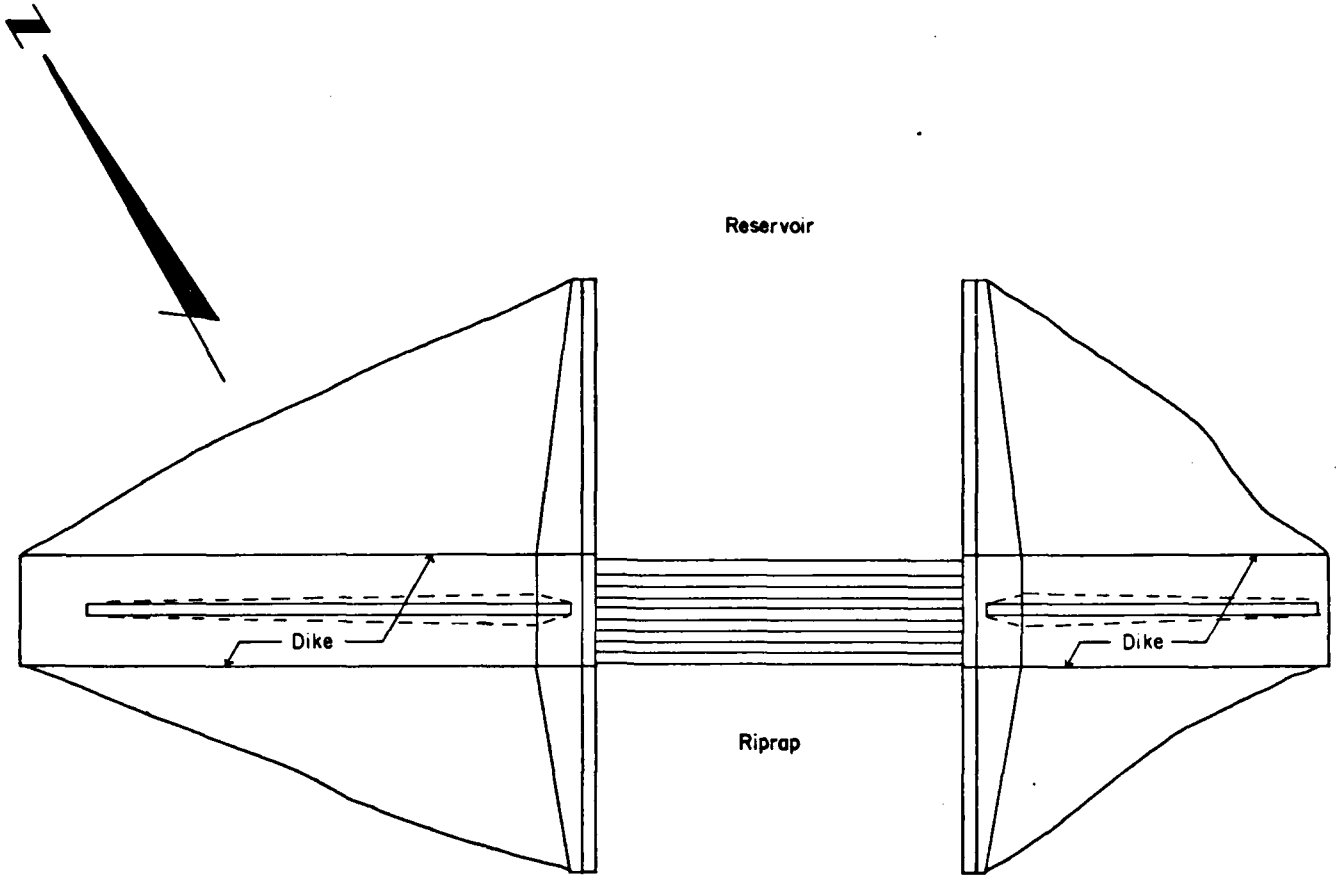
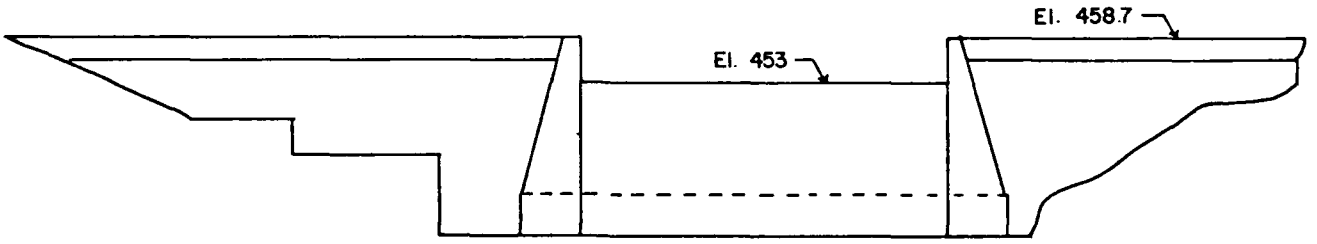
BUCKINGHAM RESERVOIR DAM



PLAN OF SPILLWAY

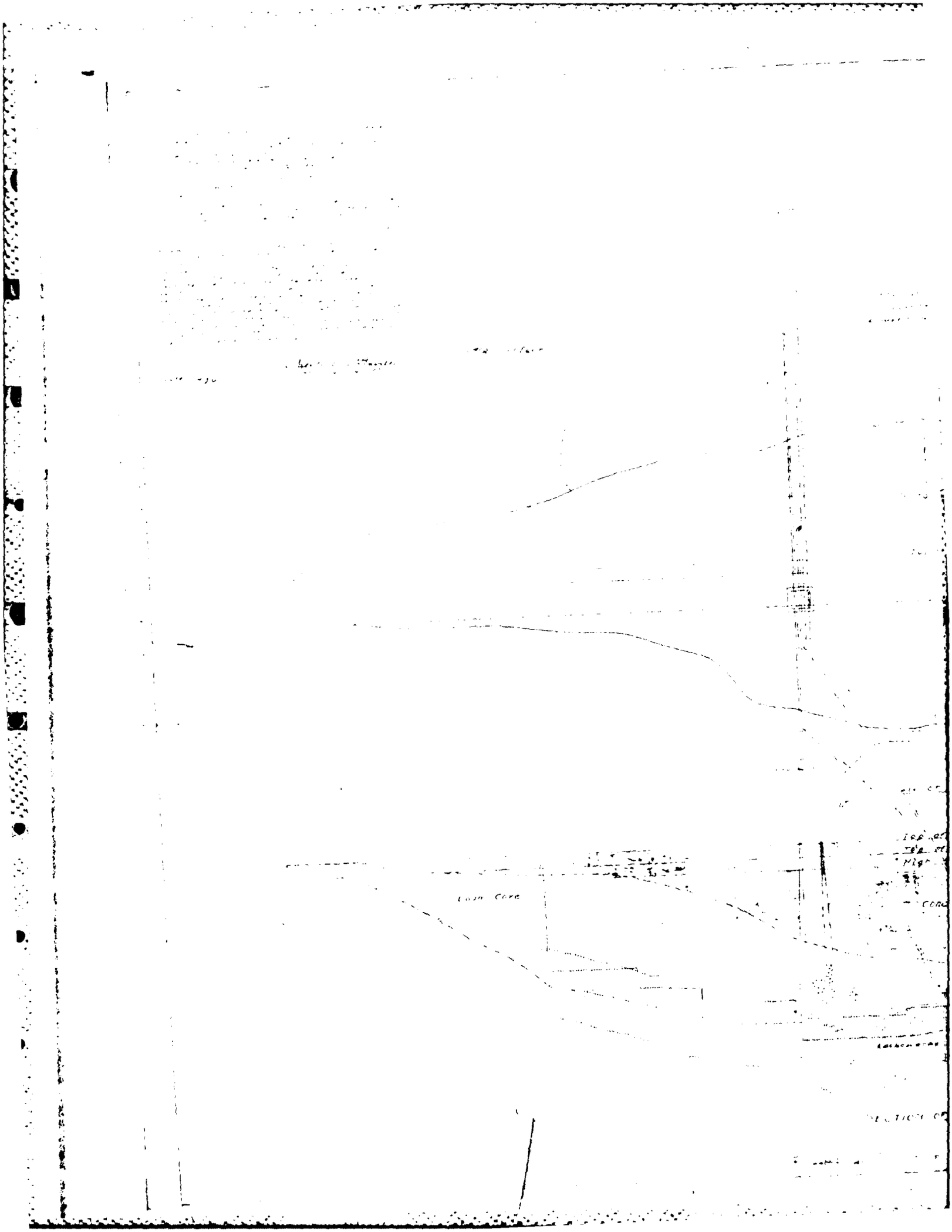
NTS

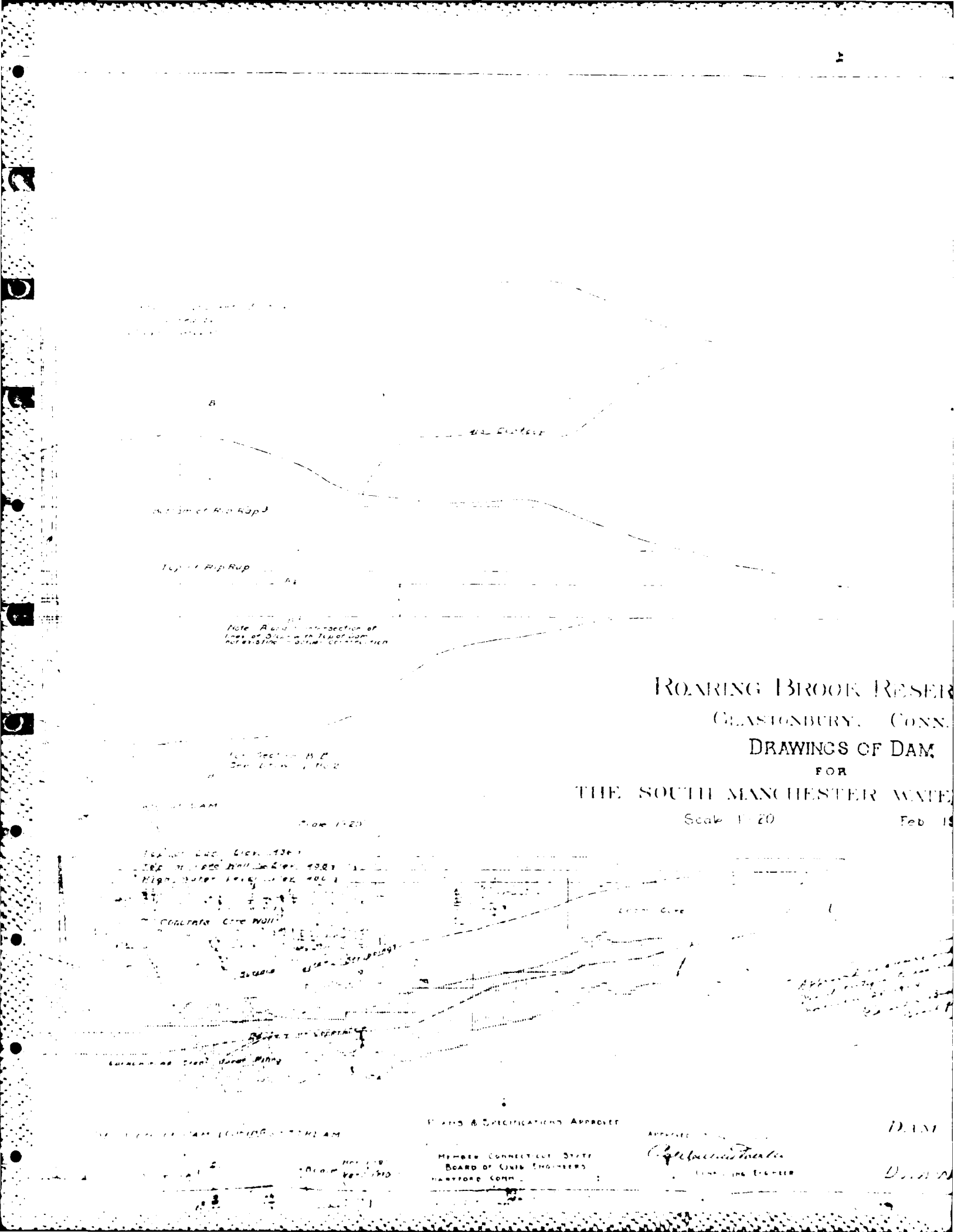


PROFILE OF SPILLWAY

NTS

BUCKINGHAM RESERVOIR DAM





ROARING BROOK RESER

GLASTONBURY, CONN.

DRAWINGS OF DAM

FOR

THE SOUTH MANCHESTER WATE

Scale 1" = 20' Feb 19

PLANS & SPECIFICATIONS APPROVED

MEMBER CONNECTICUT STATE BOARD OF CIVIL ENGINEERS

HARTFORD CONN.

DAM

ROARING BROOK RESERVOIR

GLASTONBURY, CONN.

DRAWINGS OF DAM

FOR

THE SOUTH MANCHESTER WATER COMPANY

Scale 1" = 20' Feb 1923

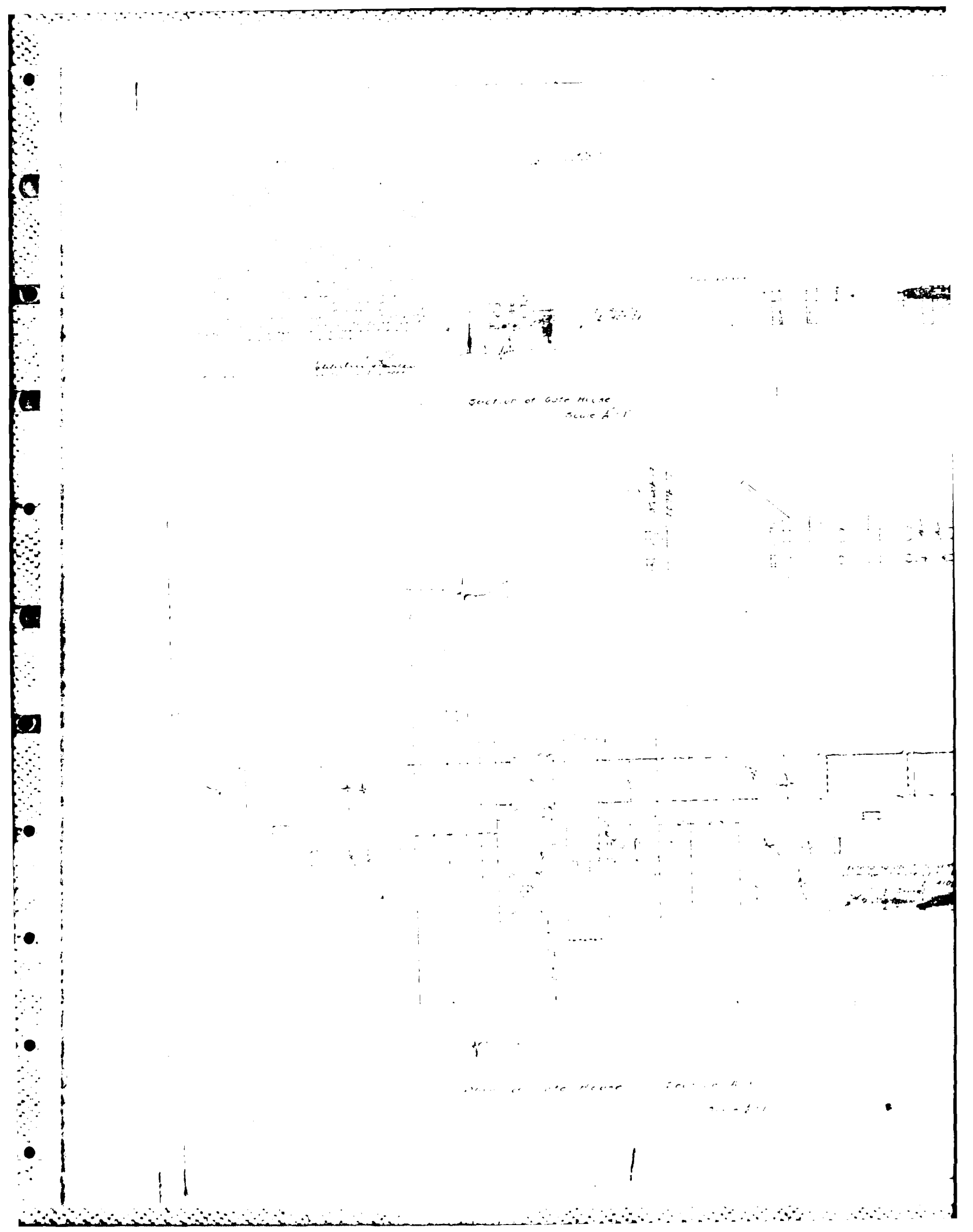
PLANS & SPECIFICATIONS APPROVED

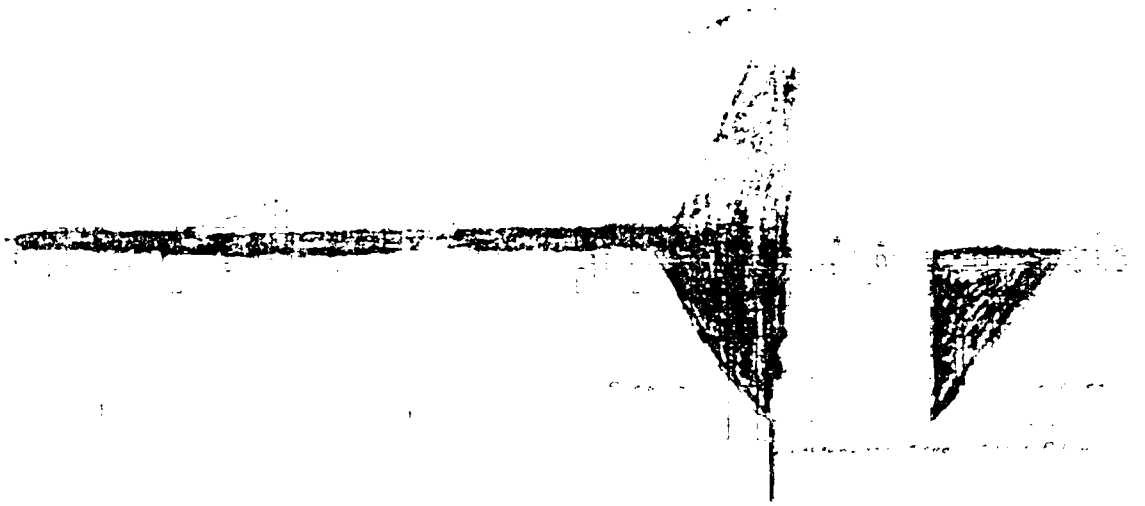
MEMBER CONNECTICUT STATE
BOARD OF CIVIL ENGINEERS
HARTFORD CONN.

DAM No. 1

DRAWING No. 1

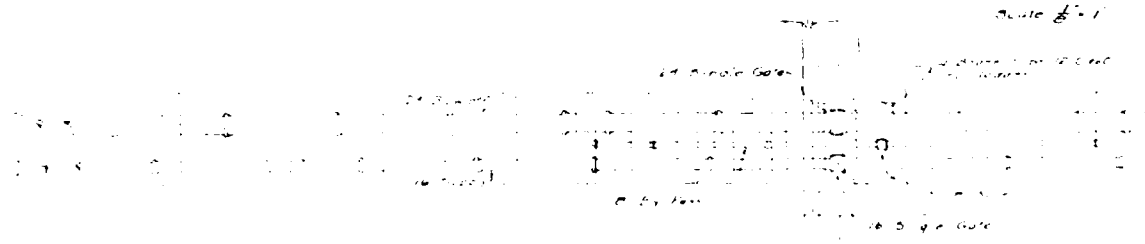
R. S.





Section of Dam thru Gate House

Scale 1/8" = 1'



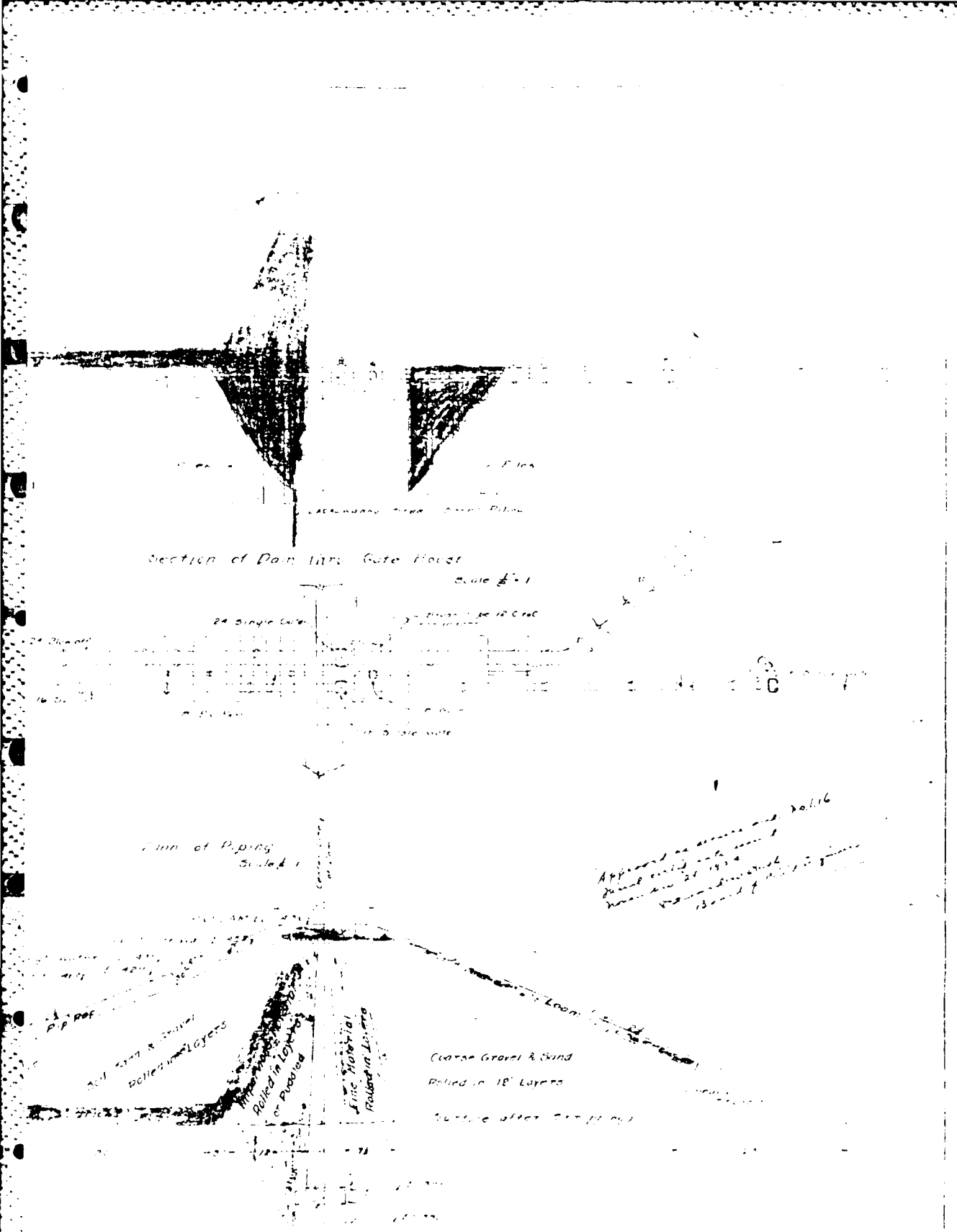
Plan of Piping

Scale 1/8" = 1'

DRAWINGS

FOR

THE SOUTH MANCHESTER



TOWNSEND BROOK RESERVOIR
GRANVILLE, MASS.

DRAWINGS OF DAM

FOR

THE SOUTH MANCHESTER WATER COMPANY

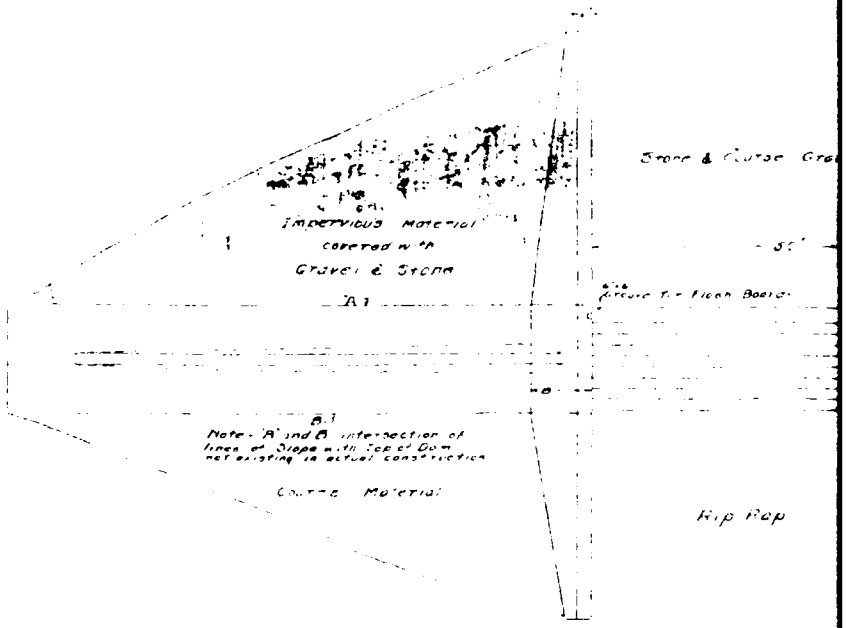
Scale 1" = 1'

DAM No. 1

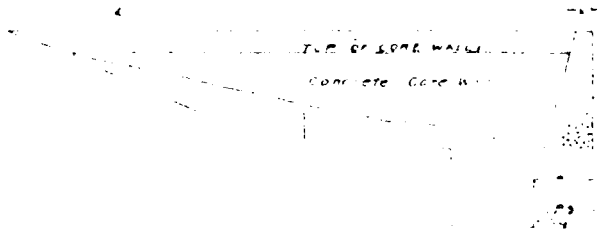
CONSULTING ENGINEER

3

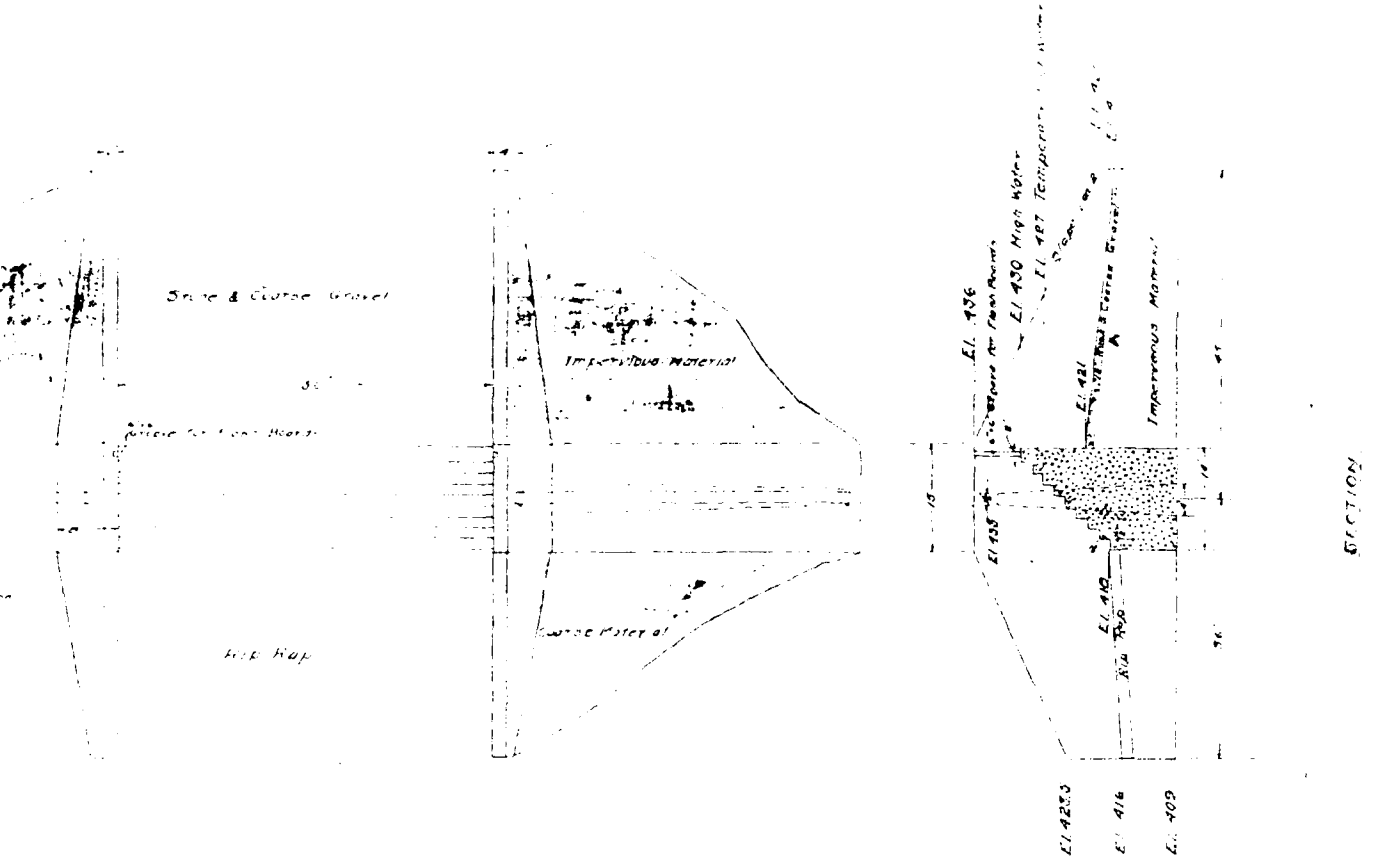
B-6



PLAN OF

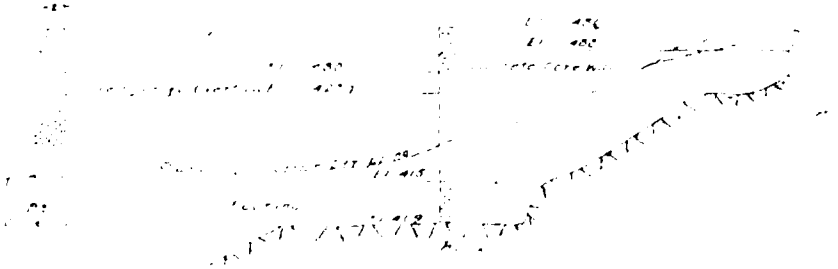


ELEVATIO



SECTION

PLAN of SPILLWAY



ELEVATION

PLANS & SPECIFICATIONS APPROVED

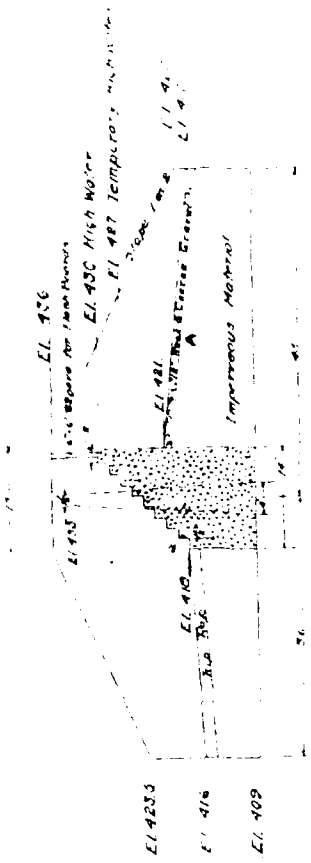
MEMBER CONNECTICUT STATE
BOARD OF CIVIL ENGINEERS
HARTFORD CONN.

APPROVED FOR

Consulting Engineer

FLOATING P
GLAST
DRAW

THE SOUTH MANCH
Scale 1" = 8'



SECTION

ROARING BROOK RESERVOIR
GLASTONBURY, CONN.
DRAWINGS OF DAM
FOR
THE SOUTH MANCHESTER WATER COMPANY
Scale 1" = 10' Feb. 1934
DAM No. 1

PLANS & SPECIFICATIONS APPROVED

MEMBER CONNECTICUT STATE

FORM PUR STO 201

INTERDEPARTMENT MAIL

DATE: March 29, 1968

TO: File

DEPARTMENT:

FROM: William H. O'Brien, III, Civil Engineer

DEPARTMENT: Water Resources Commission

SUBJECT: Buckingham or Roaring Brook Reservoir, Glastonbury

An unidentified person called this office on March 27, 1968 and reported a leak on the dam at Roaring Brook Reservoir in Glastonbury which he thought was owned by the Manchester Water Company (actual owner: Town of Manchester Water Department - two separate companies). Because of this call, the undersigned visited the site on March 28, 1968.

The 350' ± earth dike along the west of the reservoir seemed to be in very good condition. There was a mixture of some moss with good grass cover over the entire downstream slope but with no mushy areas on the slope. From the toe of the slope out for about 100 feet from the dam, there is water standing up to 6 inches deep in places in a very marshy area. The ground beneath the water had grass cover and was not unduly soft and had been in this condition since the dam was built back in the 1920's per Mr. Lockwood of the Water Department. This is not considered a source of concern. There was a depression, however, about 10 feet out from the toe of the dam nearly in line with the gate house and toe drain sump hole (see attached sketch). These items brought to the attention of the Water Department in letter dated March 29, 1968.

The dam on the south side of the reservoir is an earth dam (75'± in length west of the spillway and 50' to the east). The spillway is about 50' in length and is built in step fashion out of stone with concrete wing walls. There are many trees growing on the downstream side of the earth embankments and water was noticed boiling in a 6" depth of water at the base of the westerly wing wall. These items brought to the attention of the Water Department in letter dated March 29, 1968. There was no evidence of fine material being carried out by this flow.

William H. O'Brien III

Civil Engineer

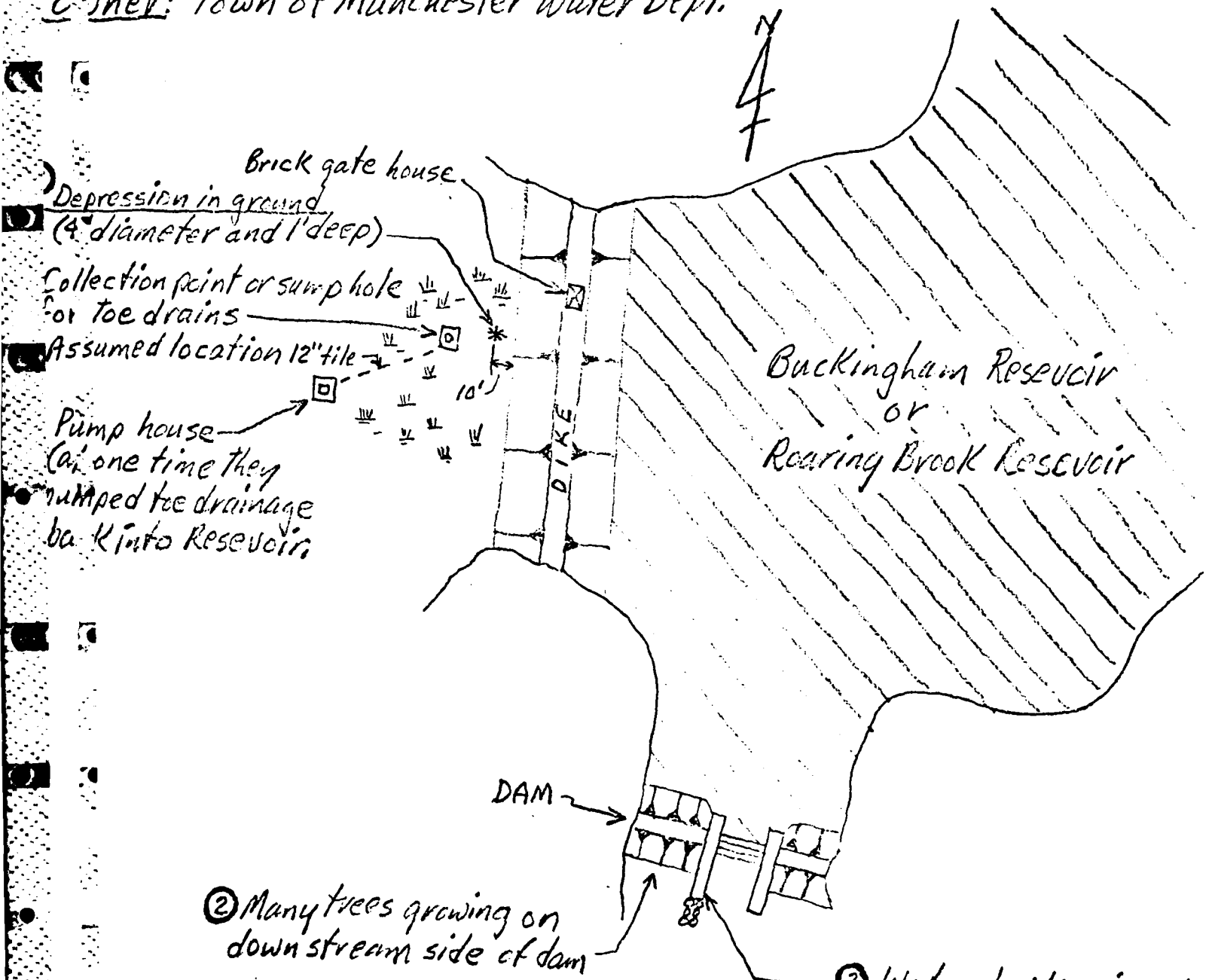
tvm

Attached sketch

Buckingham Reservoir or Roaring Brook Reservoir, Glastonbu

Field Inspection on March 28, 1968

Owner: Town of Manchester Water Dept.



Items ①, ② + ③ brought to attention of Town of Manchester Water Dept. in letter dated 3/29/68

W. H. O'Brien

March 29, 1968

Mr. Lawrence Wittkofske, Superintendent
Town of Manchester Water Department
Manchester, Connecticut

Roaring Brook Reservoir
Dear Mr. Wittkofske: Re: Glastonbury - Dams

As a follow up to our telephone conversation on March 28, we are sending you the results of our field inspection of Roaring Brook Reservoir or Buckingham Reservoir on March 27, 1968.

Concerning the earth dike along the west side of the reservoir, a depression approximately one foot deep and four feet in diameter was noticed about ten feet out from the toe of the slope almost in line with the gate house and toe drain sump hole. Is this over the location of a pipe? If so, an excavation should probably be made to determine if there is a hole in the pipe.

Although there was more water standing near the base of this dam than is normally the case, this does not necessarily indicate any instability of the structure* especially since it has been very wet at the base ever since the dam was built according to Mr. Lockwood. However, you indicated in our telephone conversation that there seemed to have been an increase in this flow over the past few years, but that there had been nothing noticed within the last few months to indicate that there was any urgency involved. Please summarize your observations chronologically and send us a copy of any plans which you may have.

At the dam on the south end of the lake, there were many small trees growing on the downstream earth embankment which should be cut down to avoid damage to the dam from overtopping in a storm. Also there was water boiling up in a six inch depth of water at the base of the westerly wing wall. There was no evidence that any material was being carried from within the dam in this flow but this leak should be corrected.

*in earth dams of this type e.g. P.C.

May we hear from you in the near future in regard to these items?

Very truly yours,

William H. O'Brien, III
Civil Engineer

WHOIII/tvm

REPORT

to

The Selectmen, Town of Manchester

re

S. M. WATER COMPANY

and

S. M. SANITARY AND SEWER DISTRICT

December 27, 1932

ALFRED H. TERRY CHARLES J. BENNETT

influence of the leakage at Roaring Brook on the storage capacity of the reservoir is unknown.

We have, however, conditions in the year 1931 as a guide. This year, according to the Water Company's records, was the lowest in total rainfall since 1897. The condition of the three reservoirs, therefore, in 1931, in as much as they are influenced by the leakage at Roaring Brook, gives a reasonable idea of what can be expected from the combined storage in an extremely dry year.

After giving due weight to the somewhat low quantity of water used in 1931, we find that these conditions indicate that the present supply could have cared for a population of about 66% in excess of the 1931 population.

The population at Manchester has increased since 1880 at the rate of 28% every 10 years. This, of course, is based on compounding the increase at each census. It seems likely that the rate of growth is somewhat less at present and that it is safe to say that the supply is sufficient for at least 20 years.

The design of the Roaring Brook dam is open to some criticism in that the sheeting driven to cut off leakage is not enclosed at its top by the concrete core wall. This sheeting has been surrounded with impervious material which is designed to give the necessary protection against leakage, but is not so sure a method of securing this result as would have been the method of surrounding the sheeting with concrete.

There is considerable percolation through the soil under-

neath and around this dam amounting to about 400 gallons per minute with the pond at spillway elevation. Diagram C shows the leakage in relation to pond elevations for the years 1929 to 1932 inclusive. It will appear from the diagram that the elevation of the water in the pond has considerable influence on the amount of leakage varying from 400 g.p.m. for pond at elevation 429 to 150 g.p.m. for pond at elevation 422. While the diagram is on too small a scale to show the fluctuations due to variations in rainfall the records show that rainfall has an influence on the leakage. It seems, therefore, a justifiable conclusion that the main leakage comes from the storage area, but that a portion of the leakage, perhaps considerable in amount, comes from other sources.

We do not think that this leakage is a menace to the stability of the dam. The dam has been in existence for about seven years, careful record of the amount of leakage has been kept for the last six years. This record does not indicate that the amount of leakage is increasing.

While it is impossible to determine from available information whether this leakage is concentrated or distributed throughout the length of the dam, if it is distributed, it would amount to only one gallon per minute per lineal foot of dam for the condition of 400 gallons per minute with the pond at spillway elevation.

In stating that it is our opinion that the leakage

is not a menace to the stability of the dam, we recognize that the responsibility for damage, in case of failure, would rest upon the owner of the property at the time of such failure.

The leakage at Roaring Brook dam, in our opinion, while not a menace to the stability of the dam, does decrease the available water supply and makes the useful life of the dam less than would otherwise be the case. This fact is given weight in applying depreciation to this particular structure.

There is about four miles of wood stave pipe laid from the Roaring Brook dam to the filter plant at Line Street. In as much as the probable life of wood stave pipe is from 20 to 25 years it is evident that this pipe will have to be replaced about 1950.

This makes the date for replacing the wood stave pipe approximately the same as that when additional storage will be required. About this time also the present bond issue of $500,000 is due for retirement.

The Roaring Brook supply is filtered at Line Street. This plant is good for approximately twice its present use so that additional expense at this point is not to be anticipated for some time to come.

The Porter Howard supply is not at present filtered although it is sterilized. The upper part of the Porter water shed is swampy. Normally the water from this portion of the shed is bypassed and not used. If used, under the present conditions, it is aerated to some

BUCK & BUCK

ENGINEERS

71 CAPITOL AVENUE, HARTFORD, CONNECTICUT 06103

JAMES A. THOMPSON
ROBINSON W. BUCK

Comm. 5713-48

November 20, 1968

Mr. William H. O'Brien III
Water Resources Commission
State Office Building
Hartford, Connecticut 06115

Roaring Brook Res. Dam 7 Files
(Buckingham Reservoir)

Dear Bill:

As requested, we made an inspection on even date of the Buckingham Reservoir. As in previous inspections, the water level was quite low, being 57 inches below the normal spillway level. We observed the depression near the downstream toe of the slope. However, it was dry. There is a two-inch diameter hole in the bottom of the depression but it, too, was dry.

In general the entire base of the dike was drier than we had expected it to be. However, the underdrains were still quite active. The downstream area of the spillway, at the southerly end of the reservoir was also dry. We are sure these conditions are due to the relatively low water level. We will continue to check the site periodically and should we detect an alarming increase in the seepage rate or locate a possible "boil" we will notify you immediately.

Sincerely yours,

BUCK & BUCK

James A. Thompson

James A. Thompson

BUCK & BUCK

ENGINEERS

71 CAPITOL AVENUE, HARTFORD, CONNECTICUT 06106

JAMES A. THOMPSON
ROBINSON W. BUCK

Comm. 5713-48

August 6, 1969

Mr. William H. O'Brien III
Water Resources Commission
State Office Building
Hartford, Connecticut 06115

Re: Buckingham Reservoir
Roaring Brook
Glastonbury, Connecticut

Dear Bill:

Since our initial inspection of the subject dam, we have made inspections on March 28, 1969 and July 31, 1969. During both of these inspections the water level was at, or very close to, spillway discharge. The area immediately downstream of the toe of the principle dam was very wet during both inspections. We could not discern a definite flow or velocity in this water. Flow in the underdrainage system was very active and appeared to be at a greater rate than that witnessed during our inspection of November 20, 1968.

Your letter of April 17, 1969 requested that we report on the stability of this structure. With the information available to us at the present, it is impossible for us to make an accurate appraisal of the dam. To do so, we feel it would be necessary to determine the actual locations of the phreatic surface, the structural characteristics of the embankment material, and the rate of seepage through the dam. We feel this is outside the scope of our contract and is a determination the owner should make.

This subject was discussed in the Terry & Bennett report to the Town of Manchester in 1932. It was Terry & Bennett's opinion that the dam was safe. This was based on the fact that seepage was not increasing, and the dam had performed satisfactorily for seven years.

It is our opinion that measurement of the seepage should be reinstated and recorded weekly, along with the reservoir water surface elevation. These readings could be compared with those taken previously. A significant increase in the flow would act as a warning of possible danger. To determine the phreatic line, it will be necessary to install

prizometers in the dam. It would be most informative if a series of prizometers were installed on down the downstream slope and the water levels recorded with the seepage rate and reservoir levels. This combination of information, along with soil analyses, could then be used by the owner's engineer to determine the structural stability of the dam.

In summary, we do not have enough information to make an accurate determination of the safety of this dam and recommend the owner provide the previously mentioned information for review by the Water Resources Commission.

Sincerely,

Buck & Buck

James A. Thompson

September 9, 1969

Mr. Robert B. Weiss
General Manager
Town of Manchester
Municipal Building, 41 Center Street
Manchester, Connecticut 06040

Subject: Roaring Brook Reservoir Dam
Glastonbury

Dear Mr. Weiss:

We have recently received a report from an engineering consultant to this Commission on the subject dam.

There has been some concern about the quantity of seepage emerging at the toe of this dam even though it has existed for many years. Our consultant has made many trips to the reservoir but the water has always been below full pond so that conditions of maximum seepage could not be observed. Per our letter of July 24, your Mr. William O'Neill, Director of Public Works, notified us when the pond was full and our consultant's recommendations, itemized below, are based on his observations under those conditions.

1. That a series of piezometers be installed on the downstream slope of the dam to record the water levels within the dam.

2. That weekly records be kept of the water levels in the reservoir, and piezometer tubes and the seepage rate at the toe of the dam.

3. That the Town have an engineer, registered in the State of Connecticut, combine this information with a soils analysis to determine the structural stability of the dam, and send a report thereof to the Water Resources Commission. A determination should also be made of how high the water could be in the piezometer tubes and still be insured of the safety of the dam. The installation would then be a permanent safety monitoring device.

Because of the great amount of seepage through or under this dam, we feel that this is the minimum effort required to definitely establish the safety of the dam.

Please inform this office at your earliest convenience as to your intentions.

Very truly yours,

William H. O'Brien, III
Civil Engineer

WHOIII/tvm

cc: James Thompson

Town of Manchester

Manchester, Conn. 06040

April 28, 1970

Mr. William H. O'Brien III
Civil Engineer
Water Resources Commission
State Office Building
Hartford, Connecticut 06115

RE: Roaring Brook Reservoir Dam
Glastonbury, Conn

Dear Mr. O'Brien:

Please excuse the delay in answering your letter of September 9, 1969. We wanted to observe conditions at the Reservoir during flood peaks this spring and we have come to the conclusion that as a first step in analyzing seepage conditions and the strength of the dam, we will take steps in staff to reactivate the flow measuring devices at the toe of the dam and study the correlation between seepage elevation and depth of reservoir. This will be compared with previous records to determine whether there is any material change.

Discussions have been held with consultant engineers and if it is determined, after examining the above information, that further work is necessary, we will undertake same, in all probability through a consultant. When we have developed more information, we will furnish you with same.

Thank you for your continued interest in the safety of this dam.

Sincerely,

Robert B Weiss

Robert B. Weiss
General Manager

RBW:pcd
cc: Mr. Graydon Lockwood, Superintendent of Water and Sewer Dept.
Mr. William D. O'Neill, Director of Public Works

April 1, 1971

Mr. Robert B. Weiss
General Manager
Town of Manchester
Municipal Building
41 Center Street
Manchester, Connecticut 06040

Re: Roaring Brook Resevoir Dam
Glastonbury

Dear Mr. Weiss:

On September 9, 1969 we wrote to you itemizing certain steps which should be taken to determine the safety of this structure. It is our engineering consultant's opinion that these steps should be taken in order to adequately determine the stability of the dam.

In your letter of April 28, 1970 you state that steps would be taken in staff to reactivate the flow measuring devices at the toe of the dam and study the correlation between seepage elevation and depth of reservoir, and that this would be compared with previous records to determine whether there is any material change. You also stated that "when we have developed more information, we will furnish you with same".

In our letters to you dated September 23, 1970 and January 20, 1971 we have requested you to inform this department as to what steps you have taken in accordance with your letter of April 28, 1970. Unless we receive assurances that the items mentioned in our letter of September 9, 1969 will be implemented in the near future, it will be our recommendation at the April 19, 1971 meeting of the Water Resources Commission that an Order be issued to the Town of Manchester, to make sufficient investigations to demonstrate the safety of the structure or if the structure is found to have only marginal safety to take whatever actions are necessary to place this structure in a safe condition or to remove it.

Very truly yours,

William H. O'Brien, III
Civil Engineer

WHO:ljg

cc: James Thompson
Walter Senkow

Town of Manchester

Manchester, Conn. 06040

April 8, 1971

Mr. William H. O'Brien, III
Civil Engineer
State of Connecticut Water Resources Commission
State Office Building
Hartford, Connecticut 06115

Re: Roaring Brook Reservoir Dam

Dear Mr. O'Brien:

I have enclosed a graph showing the correlation between reservoir height elevation and seepage beneath the dam. It appears that there has been no change over the years.

I believe this data is conclusive in itself but we are conducting one additional flow measurement.

I would welcome an opportunity to review this information with you at your convenience.

Very truly yours,

William D. O'Neill
Director of Public Works

WDO'N:s
Enc.

cc: Robert B. Weiss, General Manager
James Thompson, Buck & Buck, Engineers, 71 Capitol Ave. Hartford, Conn.
Walter J. Senkow, Town Engineer
Thomas Walsh, Junior Engineering Aide, Water & Sewer Dept.

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

STATE OFFICE BUILDING HARTFORD, CONNECTICUT 06115

16 March 1977

Mr. Frank Jodaitis
Water and Sewer Dept.
Town Hall
41 Center Street
Manchester, CT 06040

Re: Buckingham Res.(Roaring Brook Res.)
Glastonbury

Dear Mr. Jodaitis:

According to records maintained in this office, the above-mentioned dam is under your ownership.

Section 25-110 (Public Law No. 571, 1975 Revision of the General Statutes), a copy of which is enclosed, places under the jurisdiction of this department all dams, which by breaking away or otherwise, might endanger life or property. It has been determined that this dam is under our jurisdiction.

In accordance with Section 25-111 (1975 Revision of the General Statutes) this dam has been inspected. In order to maintain your dam in a safe condition, the following maintenance work or deficiencies should receive attention:

1. Brush growth on dikes and adjacent to spillway abutments should be removed.

The Water Resources Unit of the Department of Environmental Protection shall be notified within two weeks as to what steps you plan to take to accomplish this work.

If you have any questions, please contact Victor Galgowski, Supt. of Dam Maintenance, at 566-7245.

Sincerely,

Edward J. Daly

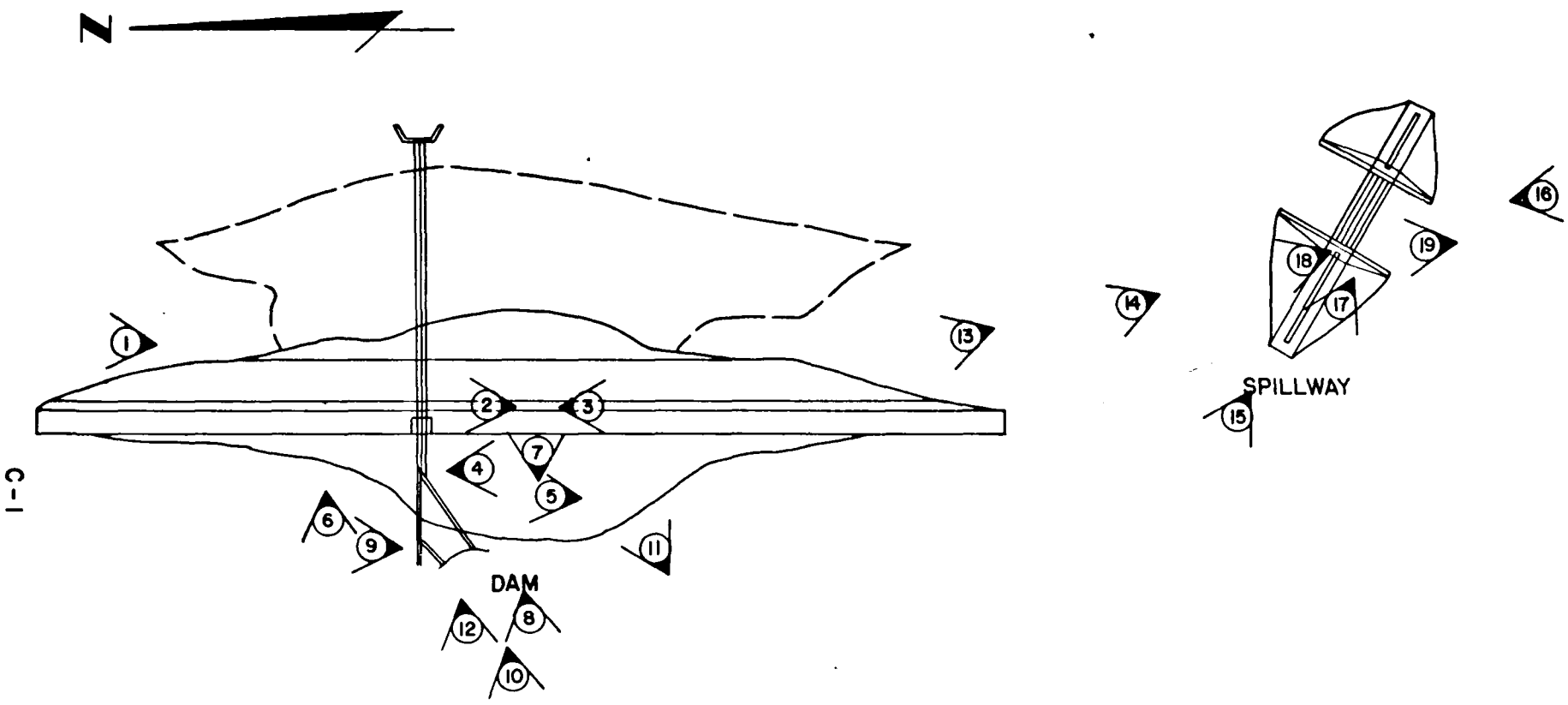
Edward J. Daly, Director
Water Resources Unit

EJD:ljk
Enclosure

MAINTENANCE FOREMAN ONSITE ON 3-23-77
AGREED TO REMOVE BRUSH. VFG.

APPENDIX C

PHOTOGRAPHS



C-1

LEGEND

(5) Number refers to caption. Arrow indicates direction of photograph.

BUCKINGHAM RESERVOIR DAM

PHOTO LOCATION MAP

PHOTO #1: Upstream face from right side.

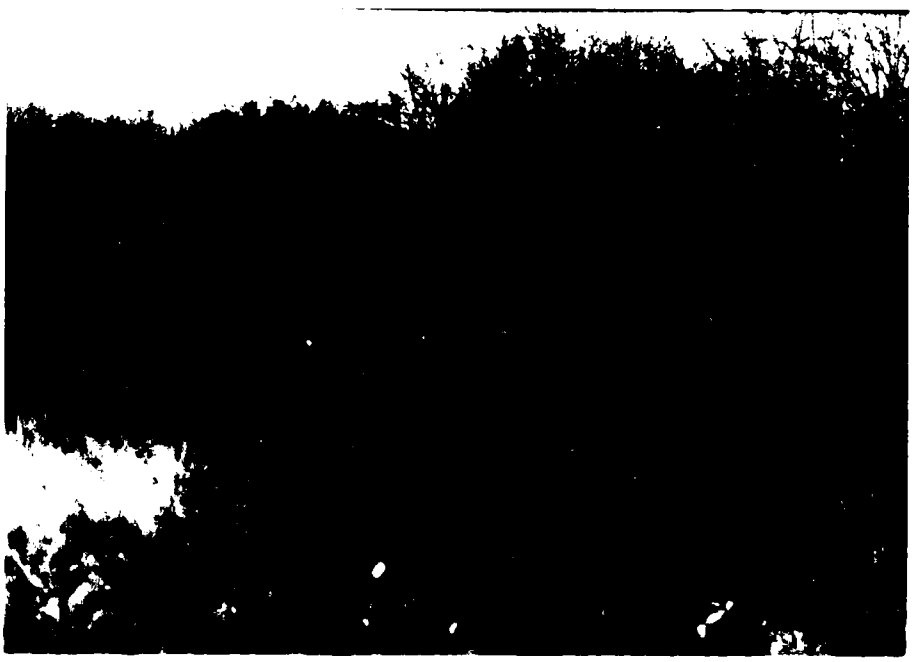


PHOTO #2: Crest of dam, looking toward left abutment.

PHOTO #3: Crest of dam, looking toward right abutment.

PHOTO #4: Downstream slope, from left abutment.

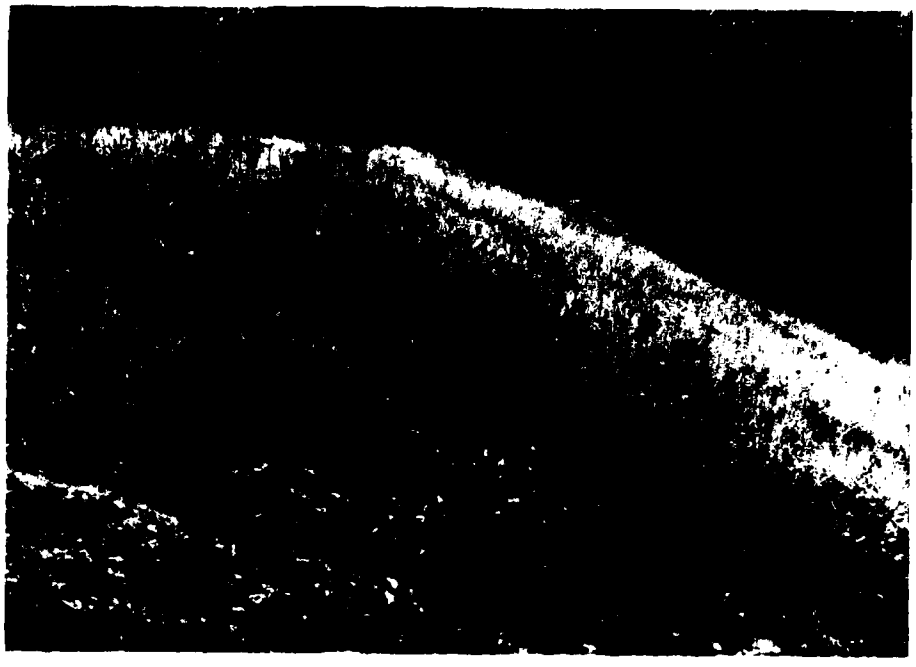


PHOTO #5: Downstream slope, looking toward left abutment.

PHOTO #6: Downstream slope, showing erosion caused from vehicular traffic.

PHOTO #7: View of downstream area from crest. The two structures in the photo contai seepage collection chambers.

PHOTO #8: Downstream slope.

PHOTO #9: Downstream slope looking toward left abutment. Screen covered seepage collection chamber in foreground.

PHOTO #10: Close-up of screen covered seepage collection chamber.

PHOTO #11: Close-up of wet area, downstream of dam.

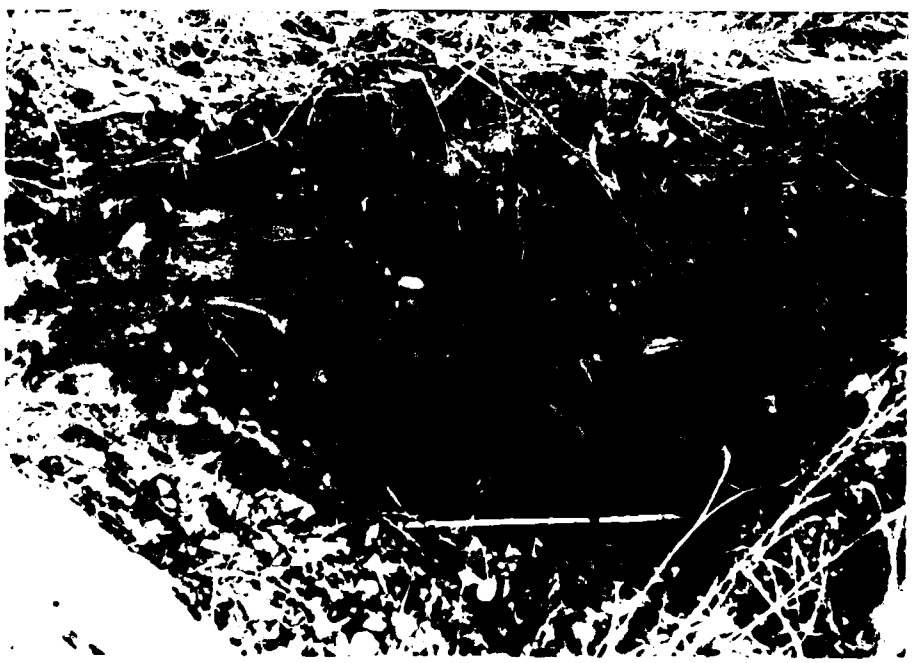


PHOTO #12: Blow-off.

PHOTO #13: Upstream face spillway and dike.

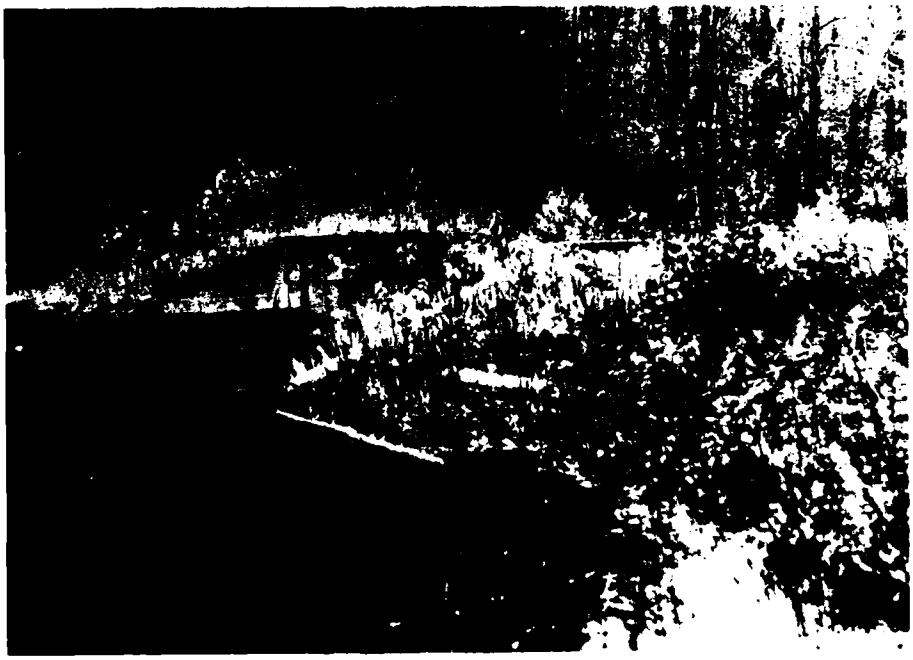


PHOTO #14: Upstream face spillway and dike.

PHOTO #15: Crest of spillway and dike, looking toward left abutment.

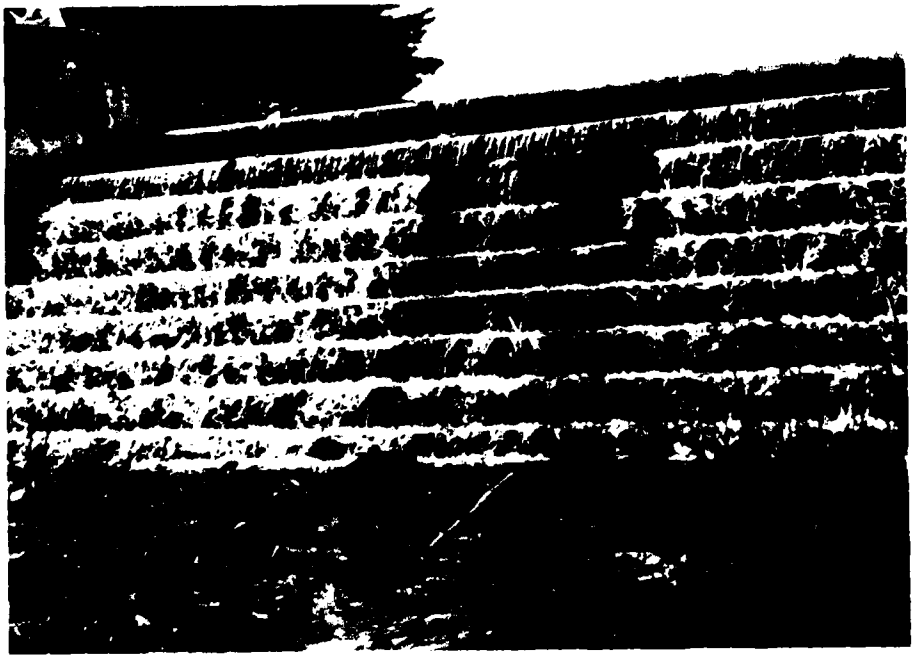


PHOTO #16: Spillway.

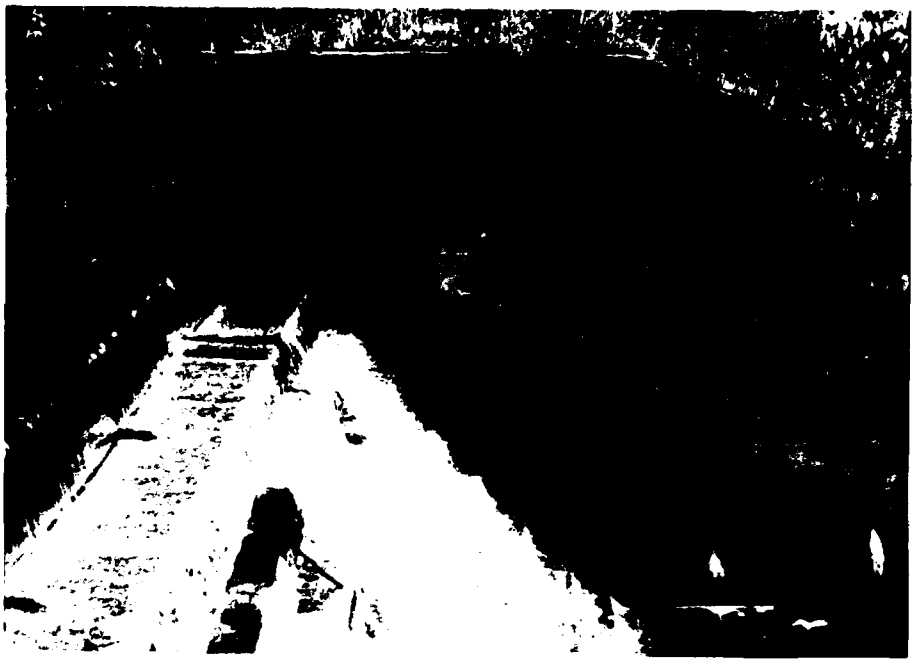


PHOTO #17: Left spillway training wall. (Note flash boards in place.)

PHOTO #18: Seepage at base of left training wall.

PHOTO #19: Downstream spillway channel.

PHOTO #20: Reservoir area.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

PROJECT 79-90-10
BUCKINGHAM RES DAM

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA NEW HAVEN, CONN 06510/203/789-1260

SHEET NO 1 OF
BY JGM DATE 3/1/80
CHK'D. BY RAC DATE 4/7/80

DETERMINATION OF SPILLWAY TEST FLOOD

A. SIZE CLASSIFICATION

Storage Volume (Ac.-Ft.) 380.5

Height of Dam (Ft.) 30

Size Classification SMALL

B. HAZARD POTENTIAL CLASSIFICATION

Category	Loss of Life	Economic Loss
Low	None expected	Minimal
(Significant)	Few	(Appreciable)
High	More than few	Excessive

Hazard Classification SIGNIFICANT

C. HYDROLOGIC EVALUATION GUIDELINES

Hazard	Size	Spillway Test Flood
Low	Small	50 to 100-Year Frequency
	Intermediate	100-Year Frequency to 1/2 PMF
	Large	1/2 PMF to PMF
(Significant)	(Small)	(100-Year Frequency) to 1/2 PMF
	Intermediate	1/2 PMF to PMF
	Large	PMF
High	Small	1/2 PMF to PMF
	Intermediate	PMF
	Large	PMF

Spillway Test Flood 100 YR

*Based upon "Recommended Guidelines for Safety Inspection of Dams" Department of the Army, Office of the Chief of Engineers, November 1976.

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA, NEW HAVEN, CONN 06510/203/789-1260

SPILLWAY TEST FLOOD

TEST FLOOD RETURN FREQUENCY = 100 YEARS.
WATERSHED AREA = 4.5 SQUARE MILES.
THE PEAK FLOW RATES ARE TO BE ESTIMATED BY USING U.S. SOIL CONSERVATION SERVICE METHODS, AS DESCRIBED IN THE BOOK "DESIGN OF SMALL DAMS" BY THE BUREAU OF RECLAMATION.

A) TRY 24 HOUR STORM DURATION
RAINFALL = 7.0 INCHES FOR 24HR DURATION
ASSUME SCS CN VALUE = 80 FOR PARTIALLY SATUATED TILL SOILS

RUNOFF = 4.7 INCHES (FIG. A-4)

TIME OF CONCENTRATION
$\Delta h = 400'$
$\Delta L = 16{,}000' = 3.03$ miles
$S = 0.025$

$$T_c = 0.00013 \frac{L^{0.77}}{S^{0.385}} = 1.0 \text{ HR}$$

$$T_p = \frac{D}{2} + 0.6\,T_c = \frac{24}{2} + 0.6(1.0) = 12.6 \text{ HR}$$

$$Q_p = \frac{484\,A\,R}{T_p} = \frac{484(4.5)(4.7'')}{12.6} = 812 \text{ CFS}$$

B) TRY STORM DURATION OF 6 HOURS
RAINFALL = 5.0 INCHES
RUNOFF = 2.7 INCHES (FIG. A-4)

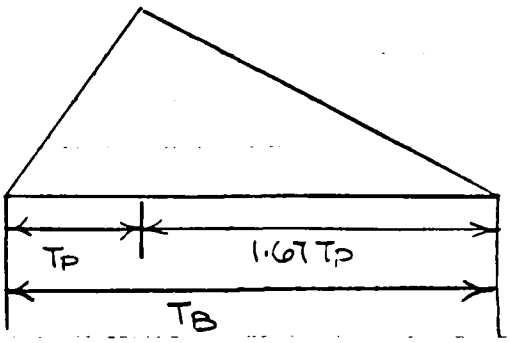
$$T_p = 6/2 + 0.6(1) = 3.6 \text{ HOURS}$$

$$Q_p = \frac{484(4.5)(2.7'')}{3.6} = 1634 \text{ CFS}$$

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA NEW HAVEN CONN 06510/203/789-1260

HYDROGRAPH

A TRIANGULAR HYDROGRAPH WILL BE USED WITH PEAK FLOW OF "Q_p" AND A BASE LENGTH OF 2.67 "T_p", FOR EACH TEST CONDITION



$T_B = 2.67\ T_P$

$T_{B_{24}} = 2.67\,(12.6) = 33.6$ HOURS

$T_{B_6} = 2.67\,(3.6) = 9.6$ HOURS

D= 6 HOURS STORM (HOURS)	PEAK FLOW (CFS)
0	0
1	454
2	908
3	1362
3.6	1634
4	1525
5	1253
6	980
7	708
8	436
9	163
9.6	0

D = 24 HOUR

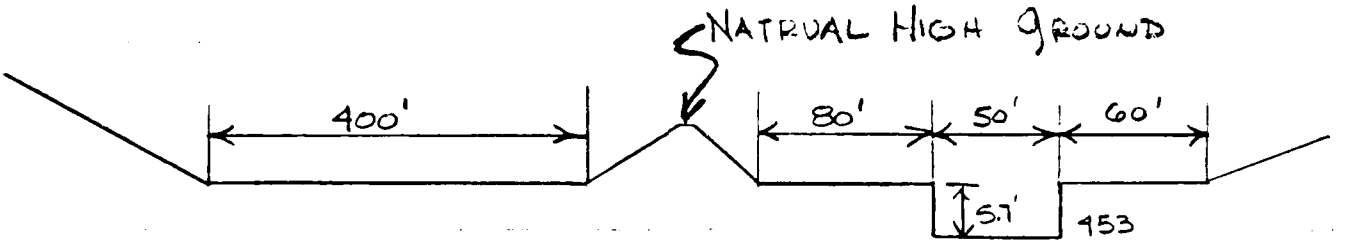
STORM (HOURS)	PEAK FLOW (CFS)
0	0
1	65
2	129
4	258
6	386
8	515
10	644
12	773
12.6	812
14	758
16	681
18	603
20	526
22	449
24	371
26	294
28	217
30	139
33.6	0

PROJECT 19010
ELLINGHAM RES DAM

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA NEW HAVEN CONN 06510 203 789 1260

SHEET NO. 5 OF
BY SAC DATE 3-7-
CHK'D. BY JGM DATE 3/14/

SPILLWAY NTS



SEGMENT	ITEM	"C"	LENGTH	ESTIMATED ELEV (NGVD)
1	EARTH EMBANKMENT GRASS	2.5	400	458.7
2	EARTH EMBANKMENT GRASS	2.5	80'	458.7
3	STONE SPILLWAY	3.0	50'	453
4	EARTH EMBANKMENT GRASS	2.5	60'	458.7

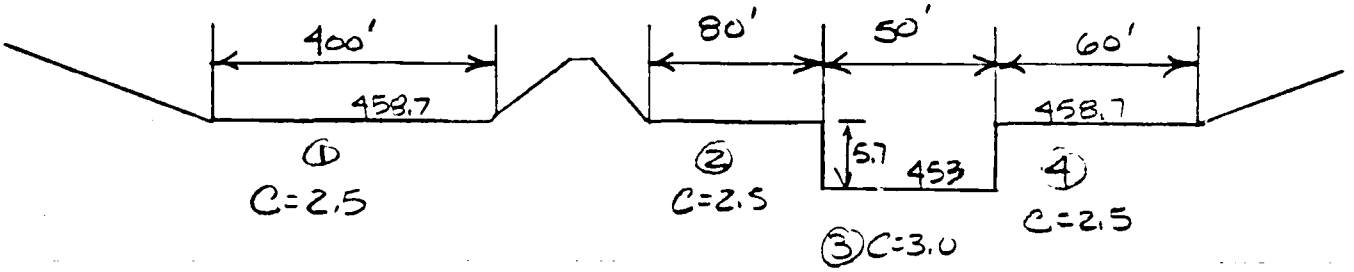
IE = 453.0
IV = 0.0
E 453' A = 35 ACRES
E 500' A = 237 ACRES

PROJECT 79010
BUCKINGHAM RES DAM

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA NEW HAVEN CONN 06510 203/789-1260

SHEET NO. 6 OF
BY RJG DATE 3-7-80
CHK'D. BY JSM DATE 3/14/80

STAGE DISCHARGE DATA

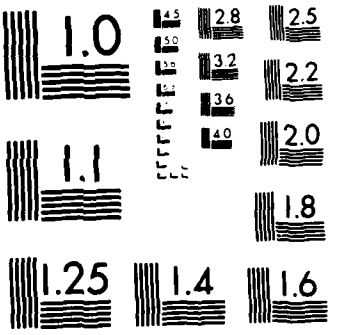


ELEV	454	455	456	457	458	458.7	460
$Q_1 = C_1 L_1 H^{3/2}$ $Q_1 = (2.5)(400) H^{3/2}$							1482
$Q_2 = C_2 L_2 H^{3/2}$ $Q_2 = (2.5)(80)(H)^{3/2}$							296
$Q_3 = C_3 L_3 H^{3/2}$ $Q_3 = (3)(50)(H)^{3/2}$	150	424	779	1200	1677	2041	2778
$Q_4 = C_4 L_4 H^{3/2}$ $Q_4 = (2.5)(60) H^{3/2}$							222
TOTAL CAPACITY	150	424	779	1200	1677	2041	4778

ALL ELEVATIONS ESTIMATED BASED ON AN ASSUMED SPILLWAY CREST EL OF 453 N.G.V.D.

AD-A143 703 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
BUCKINGHAM RESERVOIR..(U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV APR 80

UNCLASSIFIED F/G 13/13 NL



PROJECT 7990 10
PUTNAM REG

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA, NEW HAVEN, CONN 06510/203/789-1260

SHEET NO. _____ OF _____
BY RAC DATE 3-7-90
CHK'D. BY _____ DATE _____

HSE	WATER ELEV	HSE ELEV	WATER DEPTH
1	341.1	340	1.1
2	295.7	293	2.7
3	294.8	292	2.8

PROJECT BUCKINGHAM DAM

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA, NEW HAVEN, CONN 06510/203/789-1260

SHEET NO. ____ OF ____
BY JGM DATE 2/27/80
CHK'D. BY RAC DATE 4/7/80

FLOW RATE AT WEIR
GROUNDWATER DRAINAGE SYSTEM

$H = 2''$ DEPTH OF FLOW AT CREST
$L = 3.0'$ LENGTH OF WEIR
$C = 2.4$ KINGS HANDBOOK, TABLE 5-3, 5TH ED.

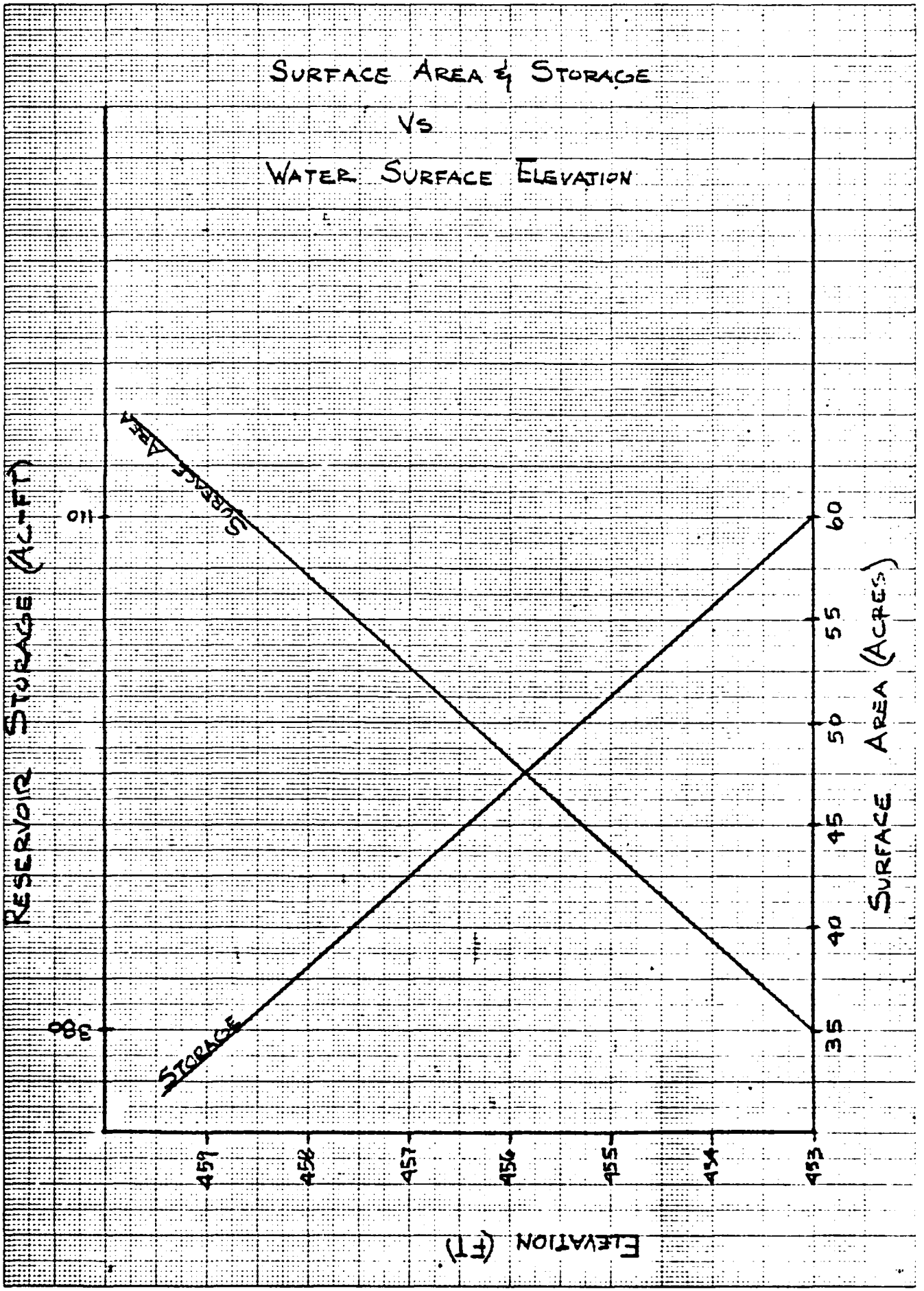
$$Q = CLH^{3/2}$$

$$Q = 2.4(3.0)\left(\frac{2''}{12}\right)^{1.5} = 0.49 \text{ CFS} = 220 \text{ GPM}$$

NOTE 1
THIS REPRESENTED ONLY ONE OF SEVERAL DISCHARGE POINTS.

79-90 10
BUCKINGHAM RES. DAM

RAC 3-7-80

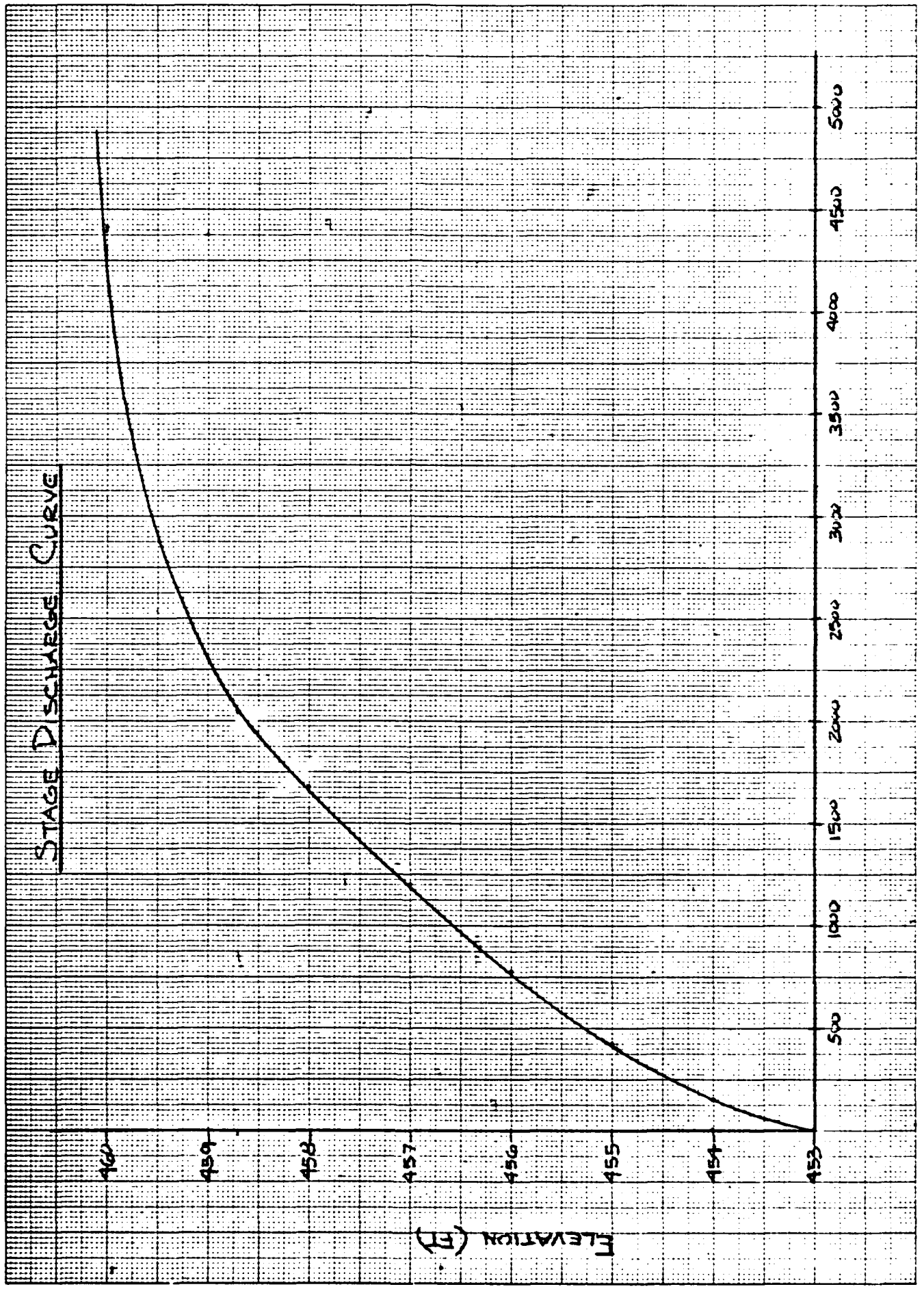


D-9

79 90 10

RAC 3-7-80

BUCKINGHAM RES



D-10

UCKINGHAM RES. DAM 799010 FLOOD ROUTING 6 HOUR RAC MARCH 7, 1980

NPUT DATA: UNSUBMERGED WEIR

EGMENT 1	DISCHARGE COEFFICIENT =	2.5	LENGTH OF WEIR =	400	ELEVATION OF WEIR =	458.7
EGMENT 2	DISCHARGE COEFFICIENT =	2.5	LENGTH OF WEIR =	80	ELEVATION OF WEIR =	458.7
EGMENT 3	DISCHARGE COEFFICIENT =	3	LENGTH OF WEIR =	50	ELEVATION OF WEIR =	453
EGMENT 4	DISCHARGE COEFFICIENT =	2.5	LENGTH OF WEIR =	60	ELEVATION OF WEIR =	458.7

IE=453.0 IV= 0.0 E=453.0 A= 35.00 E=500.0 A=237.00

HOUR	INFLOW	MASS INFLOW	WATER EL.	TAIL WATER	OUTFLOW	MASS OUTFLOW	STORAGE(R)	STORAGE(A)
0.00	0CFS	0.00AC-F	453.00FT	.00FT	0CFS	0.00AC-F	0.00AC-F	0.00AC-F
1.00	454CFS	18.76AC-F	453.46FT	0.00FT	47CFS	1.97AC-F	16.78AC-F	16.78AC-F
2.00	908CFS	75.04AC-F	454.54FT	0.00FT	287CFS	15.84AC-F	59.19AC-F	59.19AC-F
3.00	1,362CFS	168.84AC-F	455.75FT	0.00FT	686CFS	56.09AC-F	112.74AC-F	112.74AC-F
3.60	1,634CFS	243.12AC-F	456.44FT	0.00FT	960CFS	96.91AC-F	146.21AC-F	146.21AC-F
4.00	1,525CFS	295.33AC-F	456.80FT	0.00FT	1,112CFS	131.16AC-F	164.16AC-F	164.16AC-F
5.00	1,253CFS	410.13AC-F	457.12FT	0.00FT	1,257CFS	229.09AC-F	181.03AC-F	181.03AC-F
6.00	980CFS	502.40AC-F	456.96FT	0.00FT	1,183CFS	329.95AC-F	172.44AC-F	172.44AC-F
7.00	708CFS	572.15AC-F	456.55FT	0.00FT	1,006CFS	420.44AC-F	151.71AC-F	151.71AC-F
8.00	436CFS	619.42AC-F	456.01FT	0.00FT	784CFS	494.45AC-F	124.97AC-F	124.97AC-F
9.00	163CFS	644.18AC-F	455.36FT	0.00FT	545CFS	549.41AC-F	94.76AC-F	94.76AC-F
9.60	0CFS	648.22AC-F	454.92FT	0.00FT	400CFS	572.87AC-F	75.35AC-F	75.35AC-F

BUCKINGHAM RES. DAM 799010 FLOOD ROUTING 24 HOUR RAC MARCH 7, 198

INPUT DATA: UNSUBMERGED WEIR

SEGMENT 1	DISCHARGE COEFFICIENT =	2.5	LENGTH OF WEIR =	400	ELEVATION OF WEIR =	458.7
SEGMENT 2	DISCHARGE COEFFICIENT =	2.5	LENGTH OF WEIR =	80	ELEVATION OF WEIR =	458.7
SEGMENT 3	DISCHARGE COEFFICIENT =	3	LENGTH OF WEIR =	50	ELEVATION OF WEIR =	453
SEGMENT 4	DISCHARGE COEFFICIENT =	2.5	LENGTH OF WEIR =	60	ELEVATION OF WEIR =	458.7

IE=453.0 IV= 0.0 E=453.0 A= 35.00 E=500.0 A=237.00

HOUR	INFLOW	MASS INFLOW	WATER EL.	TAIL WATER	OUTFLOW	MASS OUTFLOW	STORAGE(R)	STORAGE(A)
0.00	0CFS	0.00AC-F	453.00FT	.00FT	0CFS	0.00AC-F	0.00AC-F	0.00AC-F
1.00	65CFS	2.68AC-F	453.07FT	0.00FT	2CFS	0.12AC-F	2.56AC-F	2.56AC-F
2.00	129CFS	10.70AC-F	453.26FT	0.00FT	20CFS	1.11AC-F	9.59AC-F	9.59AC-F
4.00	258CFS	42.68AC-F	453.82FT	0.00FT	113CFS	12.20AC-F	30.48AC-F	30.48AC-F
6.00	386CFS	95.90AC-F	454.40FT	0.00FT	251CFS	42.30AC-F	53.60AC-F	53.60AC-F
8.00	515CFS	170.37AC-F	454.90FT	0.00FT	395CFS	95.73AC-F	74.63AC-F	74.63AC-F
10.00	644CFS	266.15AC-F	455.33FT	0.00FT	535CFS	172.68AC-F	93.47AC-F	93.47AC-F
12.00	773CFS	383.26AC-F	455.71FT	0.00FT	671CFS	272.39AC-F	110.86AC-F	110.86AC-F
12.60	812CFS	422.56AC-F	455.82FT	0.00FT	711CFS	306.66AC-F	115.89AC-F	115.89AC-F
14.00	758CFS	513.38AC-F	455.94FT	0.00FT	758CFS	391.66AC-F	121.71AC-F	121.71AC-F
16.00	681CFS	632.31AC-F	455.86FT	0.00FT	727CFS	514.42AC-F	117.88AC-F	117.88AC-F
18.00	603CFS	738.42AC-F	455.68FT	0.00FT	659CFS	629.02AC-F	109.40AC-F	109.40AC-F
20.00	523CFS	831.48AC-F	455.47FT	0.00FT	583CFS	731.75AC-F	99.73AC-F	99.73AC-F
22.00	449CFS	911.81AC-F	455.25FT	0.00FT	507CFS	821.96AC-F	89.85AC-F	89.85AC-F
24.00	371CFS	979.58AC-F	455.02FT	0.00FT	433CFS	899.75AC-F	79.83AC-F	79.83AC-F
26.00	294CFS	1,034.54AC-F	454.78FT	0.00FT	358CFS	965.16AC-F	69.38AC-F	69.38AC-F
28.00	217CFS	1,076.77AC-F	454.52FT	0.00FT	283CFS	1,018.21AC-F	58.56AC-F	58.56AC-F
30.00	139CFS	1,106.19AC-F	454.25FT	0.00FT	210CFS	1,059.02AC-F	47.17AC-F	47.17AC-F
33.60	0CFS	1,126.87AC-F	453.66FT	0.00FT	82CFS	1,102.48AC-F	24.38AC-F	24.38AC-F

BUCKINGHAM RES. — 799010 RAC APRIL 7, 1980

FGA FLOOD WAVE ROUTING

APPROXIMATE FLOOD WAVE ROUTING BASED UPON U.S. ARMY CORPS OF ENGINEERS' "RULE OF THUMB GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS" DATED APRIL, 1978.

INITIAL STATION = 0 +0
INITIAL BASE FLOW = 2,041 CFS
INITIAL WAVE HEIGHT = 30.0 FT
ASSUMED BREACH WIDTH = 80.0 FT
INITIAL RESERVOIR STORAGE = 380 ACRE-FT
COMPUTED FLOOD WAVE PEAK FLOW = 22,087 CFS
TOTAL FLOOD WAVE PEAK FLOW = 24,128CFS

STATION 2 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.080			
0.0 FT	500.0 FT	700.0 FT	440.0 FT		
		N = 0.050			
700.0 FT	440.0 FT	1500.0 FT	440.0 FT		
		N = 0.080			
1500.0 FT	440.0 FT	1700.0 FT	470.0 FT		

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
46.4 SF	33.0 FT	0.080	4.0 FPS	187CFS
2,257.2 SF	800.0 FT	0.050	10.2 FPS	23,202CFS
26.5 SF	19.0 FT	0.080	4.0 FPS	106CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
440.0 FT	2.8 FT	442.8 FT	2,330 SF	10.0 FPS	23,496 CFS	0.0300

BASE FLOW = 2,041 CFS BASE STAGE = 440.6 FT.

STATION 13 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.080			
0.0 FT	450.0 FT	100.0 FT	430.0 FT	250.0 FT	420.0 FT
400.0 FT	416.0 FT				
		N = 0.050			
400.0 FT	416.0 FT	404.0 FT	414.0 FT	414.0 FT	414.0 FT
418.0 FT	416.0 FT				
		N = 0.080			
418.0 FT	416.0 FT	520.0 FT	420.0 FT	600.0 FT	430.0 FT
750.0 FT	450.0 FT				

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
1,130.3 SF	217.9 FT	0.080	8.6 FPS	9,746CFS
181.2 SF	18.9 FT	0.050	20.7 FPS	3,762CFS
746.2 SF	138.4 FT	0.080	8.8 FPS	6,599CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
414.0 FT	10.5 FT	424.5 FT	2,057 SF	9.7 FPS	20,108 CFS	0.0240

BASE FLOW = 2,041 CFS BASE STAGE = 418.9 FT.

STATION 27 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.080			
0.0 FT	450.0 FT	300.0 FT	400.0 FT		
		N = 0.050			
300.0 FT	400.0 FT	304.0 FT	398.0 FT	314.0 FT	398.0 FT
318.0 FT	400.0 FT				
		N = 0.080			
318.0 FT	400.0 FT	480.0 FT	410.0 FT	620.0 FT	440.0 FT

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
488.5 SF	77.6 FT	0.080	6.3 FPS	3,093CFS
257.6 SF	18.9 FT	0.050	16.9 FPS	4,36[illegible]
1,275.0 SF	175.4 FT	0.080	6.9 FPS	8,88

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
398.0 FT	14.7 FT	412.7 FT	2,021 SF	8.0 FPS	16,342 CFS	0.0100

BASE FLOW = 2,041 CFS BASE STAGE = 404.8 FT.

STATION 40 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.080			
0.0 FT	450.0 FT	600.0 FT	400.0 FT	950.0 FT	400.0 FT
		N = 0.050			
950.0 FT	400.0 FT	954.0 FT	396.0 FT	1150.0 FT	396.0 FT
1154.0 FT	400.0 FT				
		N = 0.080			
1154.0 FT	400.0 FT	1200.0 FT	400.0 FT	1400.0 FT	430.0 FT
1750.0 FT	440.0 FT	2000.0 FT	450.0 FT		

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
1,629.2 SF	402.1 FT	0.080	1.8 FPS	2,978CFS
1,683.9 SF	207.3 FT	0.050	4.6 FPS	7,832CFS
261.9 SF	75.2 FT	0.080	1.6 FPS	432CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
396.0 FT	8.3 FT	404.3 FT	3,575 SF	3.1 FPS	11,244 CFS	0.0015

BASE FLOW = 2,041 CFS BASE STAGE = 399.7 FT.

STATION 46 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.050			
0.0 FT	420.0 FT	300.0 FT	400.0 FT		
		N = 0.080			
300.0 FT	400.0 FT	600.0 FT	394.0 FT		
		N = 0.050			
600.0 FT	394.0 FT	604.0 FT	392.0 FT	614.0 FT	392.0 FT
618.0 FT	394.0 FT	700.0 FT	400.0 FT	900.0 FT	410.0 FT
1000.0 FT	420.0 FT				

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
25.8 SF	27.9 FT	0.050	2.3 FPS	59CFS
1,457.1 SF	300.0 FT	0.080	4.3 FPS	6,353CFS
602.1 SF	138.3 FT	0.050	6.4 FPS	3,905CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
392.0 FT	9.8 FT	401.8 FT	2,085 SF	4.9 FPS	10,318 CFS	0.0067

BASE FLOW = 2,041 CFS BASE STAGE = 398.0 FT.

STATION 52 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.080			
0.0 FT	450.0 FT	500.0 FT	410.0 FT	750.0 FT	392.0 FT
		N = 0.050			
750.0 FT	392.0 FT	754.0 FT	390.0 FT	764.0 FT	390.0 FT
768.0 FT	392.0 FT				
		N = 0.080			
768.0 FT	392.0 FT	950.0 FT	410.0 FT		
		N = 0.050			
950.0 FT	410.0 FT	1350.0 FT	440.0 FT		

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
1,156.8 SF	179.7 FT	0.080	3.5 FPS	4,072CFS
260.3 SF	18.9 FT	0.050	9.3 FPS	2,431CFS
842.2 SF	131.1 FT	0.080	3.5 FPS	2,960CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
390.0 FT	14.9 FT	404.9 FT	2,259 SF	4.1 FPS	9,464 CFS	0.0030

BASE FLOW = 2,041 CFS BASE STAGE = 398.5 FT.

STATION 69 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.060			
0.0 FT	400.0 FT	750.0 FT	390.0 FT	950.0 FT	362.0 FT
		N = 0.050			
950.0 FT	362.0 FT	954.0 FT	360.0 FT	964.0 FT	360.0 FT
968.0 FT	362.0 FT				
		N = 0.080			
968.0 FT	362.0 FT	1100.0 FT	370.0 FT	1500.0 FT	400.0 FT

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
236.0 SF	58.6 FT	0.060	8.4 FPS	1,985CFS
174.3 SF	18.9 FT	0.050	17.5 FPS	3,053CFS
545.3 SF	133.9 FT	0.080	6.3 FPS	3,464CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
360.0 FT	10.1 FT	370.1 FT	955 SF	8.8 FPS	8,503 CFS	0.0180

BASE FLOW = 2,041 CFS BASE STAGE = 366.0 FT.

STATION 90 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.080			
0.0 FT	350.0 FT	100.0 FT	330.0 FT		
		N = 0.050			
100.0 FT	330.0 FT	104.0 FT	328.0 FT	114.0 FT	328.0 FT
118.0 FT	330.0 FT				
		N = 0.080			
118.0 FT	330.0 FT	300.0 FT	340.0 FT	650.0 FT	350.0 F.

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
169.3 SF	41.9 FT	0.080	5.7 FPS	976CFS
176.1 SF	18.9 FT	0.050	16.0 FPS	2,835CFS
616.6 SF	150.0 FT	0.080	5.8 FPS	3,598CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
328.0 FT	10.2 FT	338.2 FT	962 SF	7.7 FPS	7,411 CFS	0.0150

BASE FLOW = 2,041 CFS BASE STAGE = 334.3 FT.

STATION 111 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.080			
0.0 FT	350.0 FT	100.0 FT	320.0 FT	150.0 FT	316.0 FT
		N = 0.050			
150.0 FT	316.0 FT	154.0 FT	314.0 FT	164.0 FT	314.0 FT
168.0 FT	316.0 FT				
		N = 0.080			
168.0 FT	316.0 FT	300.0 FT	320.0 FT	420.0 FT	330.0 FT
500.0 FT	340.0 FT				

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
291.5 SF	62.1 FT	0.080	4.2 FPS	1,242CFS
161.8 SF	18.9 FT	0.050	10.1 FPS	1,645CFS
788.6 SF	173.4 FT	0.080	4.1 FPS	3,290CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
314.0 FT	9.4 FT	323.4 FT	1,242 SF	4.9 FPS	6,179 CFS	0.0067

BASE FLOW = 2,041 CFS BASE STAGE = 320.4 FT.

STATION 128 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.080			
0.0 FT	350.0 FT	100.0 FT	310.0 FT		
		N = 0.050			
100.0 FT	310.0 FT	104.0 FT	308.0 FT	114.0 FT	308.0 FT
118.0 FT	310.0 FT				
		N = 0.080			
118.0 FT	310.0 FT	280.0 FT	310.0 FT	380.0 FT	320.0 FT
500.0 FT	350.0 FT				

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
49.7 SF	16.9 FT	0.080	2.2 FPS	111CFS
141.5 SF	18.9 FT	0.050	6.7 FPS	950CFS
1,220.3 SF	225.3 FT	0.080	3.3 FPS	4,135CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
308.0 FT	8.3 FT	316.3 FT	1,411 SF	3.6 FPS	5,197 CFS	0.0035

BASE FLOW = 2,041 CFS BASE STAGE = 313.5 FT.

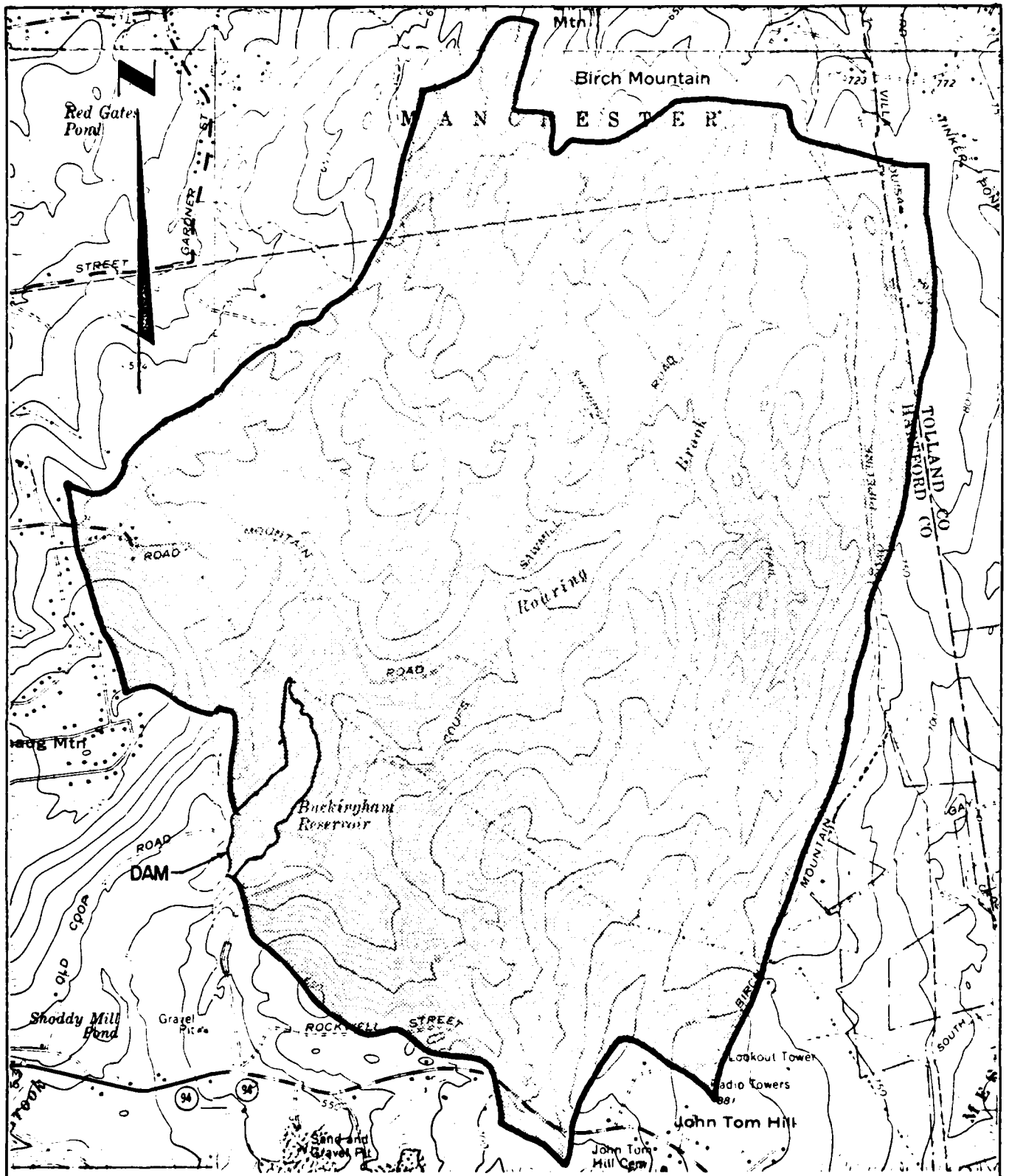
STATION 152 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.050			
0.0 FT	320.0 FT	210.0 FT	290.0 FT	214.0 FT	288.0 FT
224.0 FT	288.0 FT	228.0 FT	290.0 FT	300.0 FT	290.0 FT
420.0 FT	300.0 FT	600.0 FT	340.0 FT		

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
706.3 SF	185.5 FT	0.050	6.6 FPS	4,662CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
288.0 FT	6.9 FT	294.9 FT	706 SF	6.6 FPS	4,662 CFS	0.0083

BASE FLOW = 2,041 CFS BASE STAGE = 293.0 FT.



BUCKINGHAM RESERVOIR DAM

DRAINAGE MAP

GLASTONBURY , CONNECTICUT

FLAHERTY • GIAVARA ASSOCIATES, P.C.

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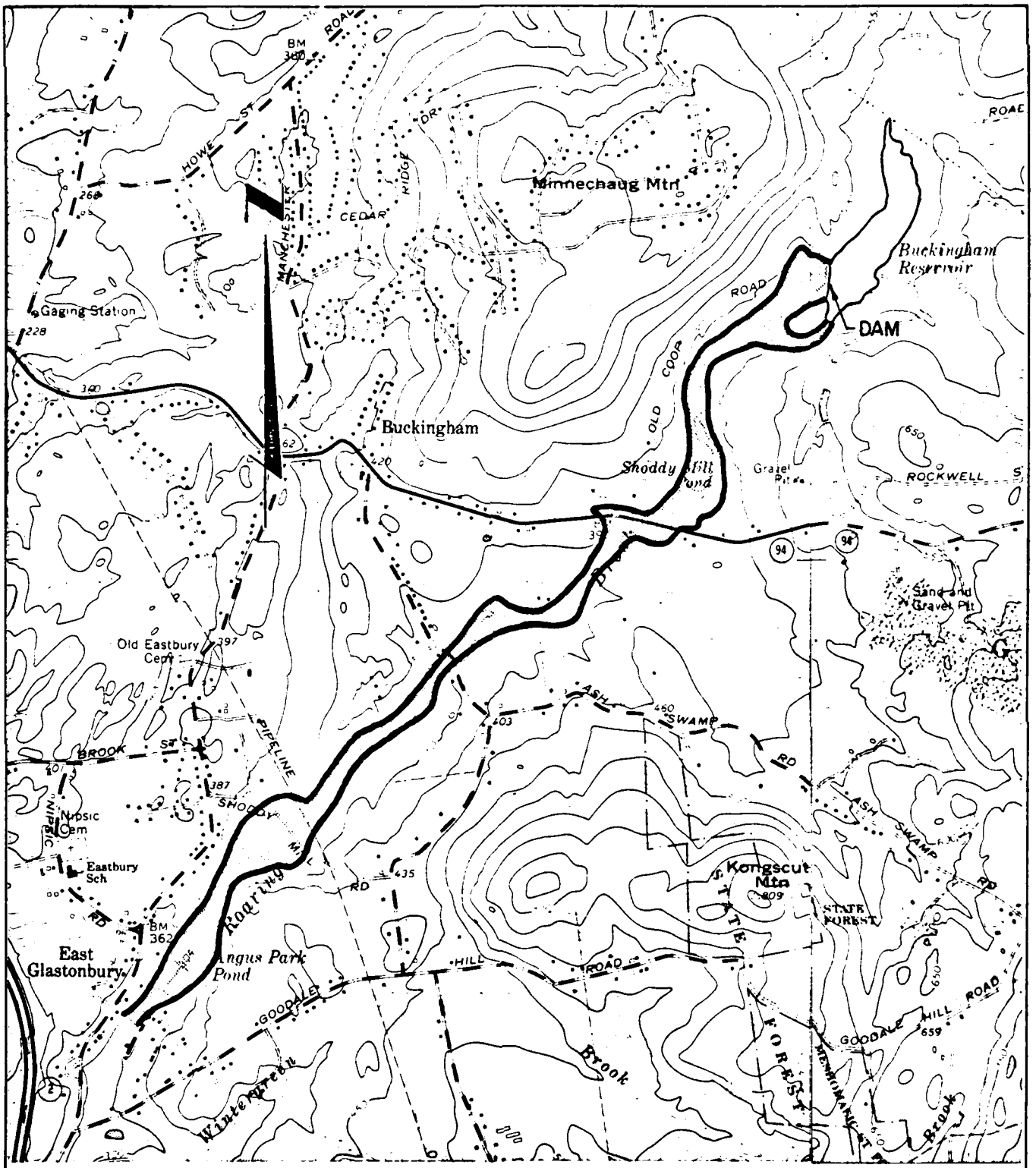

IMPACT AREA

SCALE IN FEET

2000 1000 0 2000

BUCKINGHAM RESERVOIR DAM
DAM FAILURE ANALYSIS
IMPACT AREAS
GLASTONBURY, CONNECTICUT

FLAHERTY • GIAVARA ASSOCIATES, P.C.

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APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY | MO | YR
CT	2[illegible]	[illegible]	CT	003	01				BUCKINGHAM RESERVOIR DAM	4143.0	7229.9	01APR80

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
ROARING BROOK RESERVOIR	BUCKINGHAM RESERVOIR

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY – TOWN – VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	08	ROARING BROOK	EAST GLASTONBURY	2	3500

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	(27) IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
[illegible]CRPL	1925	S	30	23	380	110	NED	N	N	N	N	

(28) REMARKS

2 -ESTIMATE

(29) D/S HAS	(30) SPILLWAY CREST LENGTH	(31) TYPE	(32) WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) POWER CAPACITY PROPOSED (MW)	(37) NAVIGATION LOCKS NO	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
2	400	U	50	2040												

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
CITY OF MANCHESTER	C SAVILES CONSULTING ENG	

(49) REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
CONN DEP	CONN DEP	CONN DEP	CONN DEP

(50) INSPECTION BY	(51) INSPECTION DATE DAY | MO | YR	(52) AUTHORITY FOR INSPECTION
FLAHERTY GIAVARA ASSOCIATES	07NOV79	P.L. 92-367

(53) REMARKS